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JOURNAL

OF

THE FRANKLIN INSTITUTE,

OF THE

State of Pennsylvania,

AND

AMERICAN REPERTORY

OF

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND OF

AMERICAN AND OTHER PATENTED INVENTIONS.

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AMERICAN REPERTORY.

JANUARY, 1847.

CIVIL ENGINEERING.

Twentieth Annual Report of the President and Directors to the Stockholders of the Baltimore and Ohio Railroad Company.

In submitting to the stockholders the twentieth annual report, the President and Directors of the Baltimore and Ohio Railroad Company have it in their power to state that the President, having returned to the United States, has resumed his duties at the head of the Company. Returning to his post only at the close of the year, however, it has been thought best that the general operations of the Company should be stated by the President pro tempore, by whom they were conducted; and for that purpose the Board refer to his letter addressed to the President, and dated the 7th of the present month.

The affairs of the Company are accurately exhibited in the following and annexed statements.

The statement A presents the state of the Company's affairs on the 30th ultimo; and the revenue and expenses of the Main Stem for the year ending on the same day, are shown by the statement B.

The tabular statement marked C, prepared by the Engineer of machinery and repairs, presents in detail the operations of the main stem, and the actual expenses of working that part of the road during the year; together with the amount of receipts from all sources during the same period. And, in order that the series of these statements should be made complete, a similar statement in regard to the main stem during the year ending the 30th September, 1845, and omitted in the report of that year, is here supplied, marked D.

These statements shew a steady increase in the transportation, both of passengers and burthen. It will be observed that the increase in the number, and in the revenue from the conveyance of passengers in the year just closed, compared with the preceding, has been more than fourteen per cent. During the same period, the augmentation in the amount of tonnage transported, has been more than thirty, and the increase in the revenue from the same source, as compared with the receipts of the preceding year, has exceeded twenty-six per cent. It will also appear from the comparative statements accompanying this report, that the cost of working the road has not been greater in proportion to the work done, than during the preceding year.

It will be seen that the nett revenue, including the receipts from the coal trade, after deducting the expenses of working and keeping the road in repair, amounted to the sum of $440,475·34—being $65,713·60 greater than the previous year, and more than six per cent. upon the capital of the Company. Of this sum, however, besides $65,749·64 (being principal, interest. and premium in sterling bills,) on account of the debt due the Messrs. Baring, there have been applied during the year to the re-construction of the road, and to the construction of burthen cars adapted to the general trade, to improvements at the depots and to right of way, to the purchase of locomotive engines and the construction of water stations, to the purchase of additional power and machinery for the accommodation of an increasing coal trade, and on account of a subscription on behalf of the Company to the capital stock of the Pittsburg and Connellsville Railroad, the further sum of $284,184·76, making together $349,934·40—and leaving of the nett revenue of the year at the disposal of the Board the sum of $90,540·94—or about one and a quarter per cent.

The motives which justified the Board in determining upon the reconstruction of the road, under the circumstances, are stated in the letter of the President, pro tempore. The Board could not doubt their sufficiency, and they were believed to be too urgent to admit of delay. The Board at the same time determined to raise the means for the re-construction of the entire length of the road between Harper's Ferry and Baltimore, by the sale of the Company's six-per cent. bonds, payable in twenty years; and believing that a sufficient sum for this purpose might in this way be raised in season to meet their engagements, they directed thirty miles of the road to be immediately placed under contract. The contracts were accordingly made, and the work embraced in them will cost not less than $316,800—and may be expected to be completed before the first day of March next.

The sale of the Company's bonds, however, was not effected according to the expectation of the Board ; and, to meet the payments under the contract, it became necessary to sell the bonds at a sacrifice varying from 8 to 10 per cent., or temporarily to apply the revenue of the year, to be hereafter reimbursed from future loans. The Board thought they best consulted the interests of the stockholders in adopting the latter alternative.

It would seem also that time had now arrived when the Board should make some definite arrangement for the reimbursement to the stockholders of the monies taken from the annual revenue and applied to the purchase of the power and machinery on account of the transportation of coal.

The coal trade in its origin, was, in some degree, experimental, and intended, for the most part, to be confined to special contracts, comprehending large amounts, to be conducted with particular regularity and at times different from the general miscellaneous business. It was intended, therefore to embrace this particular branch of transportation in a distinct account, and by charging it only with the capital actually employed and the expense of conducting it, apart from other transportation,—to be able to trace with greater certainty the results of the trade, and the extent to which it might hereafter be advantageously carried on. These objects were stated in the answers of the Board to the inquiries of the legislature, in 1844; and in the annual report of the same year, the Board acquainted the stockholders that for the purpose of successfully conducting this trade they had borrowed the capital from the revenue, and of their intention to reimburse it from the profits of the trade. The capacity to transport coal, however, at cheap rates and at a good profit, it appears has been practically ascertained; the trade itself, in consequence of the operations at the mines, and the nature of the demand, has already extended beyond the limits of special, defined contracts, and there is neither any necessity for, nor advantage in, continuing the separation of this from the other branches of transportation. The determination recently made of re-constructing the entire road between Harper's Ferry and Baltimore from the general funds of the Company, superadds another reason why the expenditures on account of the transportation of coal should hereafter be placed upon the same footing as all others incurred on account of the miscellaneous trade of the road.

Under these circumstances, the Board deem it only reasonable now to return to the stockholders what has been taken from the revenue during the past year, for the purposes of the coal trade; and for its conduct in future to rely upon the same provision as is usually made for transportation of any other description.

Upon this principle, adding the sums applied from the revenue for the re-construction of the road, and for the power and machinery for the coal trade, (after deducting the sum of $43,312·14, with which that trade has been credited,) amounting together to $146,816·05, to the residue of the surplus, as above stated, there would remain a nett surplus of revenue, over and above all other expenditures, of $237,356·99.

As a distribution of this amount among the stockholders could only be effected by a sale of the Company's bonds at the depreciation already stated, or by the delivery of the bonds at their par value to the stockholders, it became necessary to decide, not only the alternative thus presented, but the expediency of dividing only the balance of revenue actually in hand, amounting, as already shown, to about one and a quarter per cent.

In considering these questions, the Board had reason to believe that, with a knowledge of the general increase in the trade and revenues of the Company, if not on other grounds, the stockholders generally, including the state and city, had been led to expect a dividend of at least three per cent., and it was officially represented that the authorities of the city, relying upon that expectation, had omitted to make any other than a correspondent provision for the accruing interest upon the city debt.

Yielding the fullest force to these considerations, it was, at the same time, deemed inexpedient to reimburse the amount applied from the revenue to the objects already stated by a sale of the Company's bonds at so great a depreciation, and at rates which might have a tendency to impair their value in future, at least until an opportunity could be afforded of adopting reasonable means calculated to establish their just and full value.

Up to this time, the amount of bonds which the Company proposed to issue, and the specific pledge by which it was designed to secure the payment of both principal and interest, had not been limited or defined, and this had a tendency to depreciate their price. The bonds, when issued, moreover, and in the hands of citizens of Baltimore, are actually subjected to a tax by the state and city, amounting together to nearly one per cent.; an impression also generally prevails, that they would be liable to the same tax in the hands of citizens of other states, and it is certain that it would be competent for the authorities, either of the state or city, not only to create this liability, but to increase the tax according to the exigencies of either. These causes combined, have hitherto effectually prevented the sale of the bonds, unless at a sacrifice which the Board did not feel authorized to incur without every effort in its power to avoid.

The first difficulty the Board have already removed, by executing and directing to be recorded a mortgage of the property, effects, and revenue of the Company, second only to the mortgage already existing for the security of the million loan, on account of the Washington road, and by limiting the amount included in the mortgage to $1,000,000, and the application of that amount to the re-construction of the road, and the reimbursement of $58,182·64, applied during the past year to the increase of power and machinery for the coal trade.

That this measure alone will add to their value, and render the bonds more saleable, is not to be doubted; and that their exemption from tax by the state and city, would establish them at par, and perhaps enable them to be sold at a premium, is believed to be equally clear.

The cheapening of the cost of transportation, the diminution in the expenses of working and repairs, and the consequent increase of the nett revenue resulting from the reconstruction of the road, would, under any circumstances, be considered as much more than an equivalent to the city or the state for the loss of any revenue they could hope to derive from a tax upon the Company's bonds.

It is, however, only proper to remark, that not only the contracts already made in regard to the thirty miles of the road, but the early reconstruction of the entire line between Baltimore and Harper's Ferry, is not a matter of discretion, but of necessity, to be accomplished in no other way, and by no other means, than the use of the annual revenue, or by the sale of the Company's bonds at the best prices that may be obtained. In this view, that an exemption of the bonds, not exceeding one million of dollars, from taxation by the state and city, would be preferable to the sacrifice of a depreciated sale, or the loss of an annual dividend until the present engagements can be complied with, and the re-construction of the road completed, it is supposed will not be questioned by any one.

After fully weighing the foregoing considerations, the Board have felt it their duty not to incur the responsibility of producing either of the losses, or any of the inconveniences already pointed out.

They have determined, therefore, to reimburse so much of the revenue of the year as has been applied to the coal trade and to the reconstruction of the road, by the issue of the six per cent. bonds secured by the mortgage already recorded, and in preference to a sacrifice of the bonds in the market at the present prices, to pay them to the stockholders, to be used as they may deem proper.

Pursuant to these views, the Board having applied $20,000 to the sinking fund on account of the loan for the Washington road according to the pledge contained in the annual report of 1842, have declared a dividend of three per cent., or three dollars per share, payable as follows, that is to say: to all stockholders owning on the first day of the present month less than fifty shares of stock, three dollars in money on each share on and after the 20th day of November next; and to all stockholders owning on the said first day of the present month fifty shares and over, one dollar on each share in money, and two dollars in the bonds of the company, bearing six per cent. interest payable quarterly, and reimbursable in twenty years; the money to be paid and the bonds to be delivered on or after the said 20th day of November next.

By this measure, all the stockholders will receive back in undoubted securities the full amount borrowed from the revenue and applied to purposes of capital; and to those who may desire to invest their dividends, an advantageous opportunity of doing so is thereby afforded. It is hoped and believed that the partial payment of money will render it unnecessary for any to dispose of the bonds until further measures can be adopted to increase their value; and to the state and city especially, ample opportunity will be afforded, by authorizing a just exemption of the bonds from taxation, not only to raise to their full value those now to be paid on account of the dividend, but to insure the reception of an annual dividend of the profits of the road in future.

While announcing these measures, however, the Board deem it not less due to the stockholders, than an act of justice to those to be in future associated in the management of the Company, to point the attention of the stockholders *to the actual and probable state of the*

Company's affairs, during and at the termination of the year commencing with the first of the present month.

The Board, therefore, proceed to state that, on account of the contracts for the re-construction of the thirty miles of road, already explained, there will remain to be paid before the first of March next, not less than $225,000;—on account of new locomotive engines constructing under contracts executed in the months of April and May last, and payable during the same period, $70,000;—for new burthen cars now under construction, $20,000; and for improvements at the several depots, $10,000.

To these must be added the interest upon the bonds now directed to be delivered to the stockholders, and upon such temporary loans as it may be necessary to make in anticipation of the revenue, and also the installment payable during the year to Messrs. Baring, Brothers, & Co., of London, estimated together at $93,000—and forming an aggregate of existing engagements of not less than $418,000.

It will be perceived, therefore, that, independent of contingent expenses, such as rarely fail to occur in the course of a twelvemonth's operations, the revenue of the current year, if it should equal that of the past, will be absorbed by debts already incurred; and, consequently, that without disposing of the Company's bonds to meet the contracts for re-construction, it will not be in the power of the Board to make any dividend at the end of the year.

It is also to be observed, that an amount of not less than $335,000, arising out of these existing engagements, must be paid before the first of March next, and not improbably obliging the Board to dispose of a considerable amount of their bonds without regard to the state of the market; in which case it would be necessary to add the loss sustained by a depreciated sale, to the other charges upon the revenue of the year, as already explained.

It is proper, also, in this place to state, that during the last session of the Pennsylvania legislature, a law was obtained authorizing the construction of a railroad from Pittsburg to some point on the Maryland line, where it might be united with the Baltimore and Ohio railroad; and, in the expectation that it might thereby become an important *lateral* connexion of their road with the Ohio river, the Board, in the month of May last, authorized a subscription to be made on behalf of this Company for 700 shares, costing, at the par value, $35,000, in case such amount should be found necessary to secure the charter of the Pennsylvania Company. Seven hundred shares were accordingly subscribed under the authority so given; and the first installment, amounting to $1750, was paid out of the revenue of the Baltimore and Ohio Railroad Company.

It is now understood that the Pittsburg and Connellsville Railroad Company are desirous of progressing with their road with the least possible delay, and that they are not without expectations of further and greater assistance from this Company. Whatever may be the result of these expectations, it is certain that a compliance with the subscription already made will be insisted upon, and the extent to which this Company may be called upon for payment, will be an addition to the obligations, already explained, to be discharged from such resources as may be in its power.

It would seem, therefore, that without a considerable increase in the business of the road, or a like diminution in the expense of working it, and unless the Board should be enabled to dispose of the bonds, proposed to be issued, at fair prices, it is not only probable, but certain, that there can be no dividend at the end of the current year, but that the nett profits, and consequently the dividend, of the year ending September 30th, 1848, will also be materially diminished.

II.—*Of the Washington Road.*—The affairs of the Washington road are shown by the statements E and F.

These statements show an improvement in the business, and an increase in the revenue during the last half year, as compared with the preceding six months.

The nett profits, including the surplus of $6888·31 after the dividend in April last, amount to the sum of $60,576·70; of which the Board have declared a dividend among the stockholders of three dollars upon each share of stock for the last six months, payable on and after the fifteenth day of the present month, and leaving a surplus of $11,076·70, to be carried to the account of the current year.

III.—*Of the further Prosecution of the Road to the Ohio River.*—Important as a judicious and economical management of the existing work may be, and necessary as it undoubtedly is, by all the means at their command to develope and extend its present resources, the Board continue to regard the early prosecution and final completion of the road to the western waters, as their great and ultimate duty.

Considered in reference to the magnitude of the enterprize, or to the effects which may be expected from its judicious location and successful completion, the Baltimore and Ohio railroad is inferior to no work of internal improvement in this or any other country. That a short and cheap route between the states of the middle and southern valleys of the Ohio and Mississippi, and the Atlantic markets, may be found by a line from Baltimore to more than one point on the Ohio river, is not to be doubted; and, it is equally clear, that a route to which a preference is ultimately to be given, must be, in a great degree, determined by its connexions with the western country.

The line which will be the most desirable and afford the greatest facilities to the largest portion of the population of the Ohio and Mississippi valleys, and maintain the most successful competition with rival works seeking the same object, ought to be preferred by all; and, in this view, important as the work may be to Baltimore, it is not likely to be estimated less by all the states on the Ohio and Mississippi valleys. By consulting the interests of those states, their co-operation may be reasonably invoked, and time and the developments constantly in progress may be expected, at no remote day, to triumph over all the obstacles which have hitherto retarded the enterprize.

The recent legislation of Pennsylvania, referred to in another part of this report, if used with proper skill and energy by those in charge of the work it authorizes, may insure to the Company, independent of all other legislation, the opportunity of connecting their work with the Western States, if not at the best, certainly at a point possessing great advantages; and if it be not allowed to defeat the prosecution of the Baltimore and Ohio railroad *to its legitimate termination at a more southern point on the Ohio*, will deserve and ought to receive every reasonable encouragement from this Company and from the people of Baltimore. The Board, at the same time, without meaning to underrate the importance of the railroad from Pittsburg to the Maryland line, are unwilling to lose sight of the expectation that by means of the legislation of the State of Virginia, they may yet be enabled to prosecute the main stem of their road to some eligible point on the Ohio river within that state.

It is not probable that the just claims of the people of the north-western and south-western counties will be much longer neglected by the enlightened councils of that great commonwealth; and it is not unreasonable to expect that other interests, heretofore more partial to other improvements, will, at no distant day, be brought to look upon the Baltimore and Ohio railroad as the most practicable means of developing the resources of those parts of the State which have hitherto depended upon other means.

The proceedings of a numerous convention of delegates from the north-western counties of the State of Virginia, recently held at Weston, Lewis county, would appear to encourage these expectations, and to warrant the hope that so much intelligence and perseverance cannot fail ultimately to succeed.

Nor do the Board deem it unreasonable, at a period when the utmost exertions are every where making to unfetter the trade and facilitate the intercourse between different communities, to count upon the cordial co-operation of the Western States, and of the most distant parts of the Union, in support of an enterprize affording to all the easiest access to the best markets.

To no portion of the United States are works of internal improvement of greater importance, than to the states south and east of the Ohio river; and it is not to be supposed, that the people of those states will long remain insensible to this truth. Already the introduction of steam upon the western waters, has accelerated the advance of that immense region beyond that of older parts of the Union, and little remains to complete their prosperity than such means of inter-communication with the Atlantic States as, with the application of steam upon their great rivers, will unite the employment of the same power upon land.

It will be the duty of the Board, therefore, to appeal to those interests, and, by all the means in their power, endeavor to render them auxiliary to the prosecution of the great work they have in charge.

By order of the Board,

Louis McLane, *President.*

Baltimore, October 12, 1846.

(To be continued.)

The Gauge Commission.

Analysis of Evidence given before the Royal Commissioners appointed to investigate the subject of the diversity of Railway gauges.

Continued from Vol. XII Page 366.

John Urpeth Rastrick, Esq.:—The largest engine on the London and Brighton railway is one of 15-inch cylinder. Gives a preference to the cross over the longitudinal sleeper, as it is much more easily rectified and kept in order. At the time the extension of the Greenwich railway (that is, the widening out of it where the Croydon, Dover, and Brighton railways run over it,) was proposed to be done, the Directors of the Greenwich Railway Company desired their engineers (Colonel Landmann and Mr. Miller,) to make a report upon the sort of rails they ought to use in the laying down of those two lines. Each of those gentlemen made out a report; one recommended rails to be laid of the same size as those that are laid on the Croydon railway, which is a rail that has got a flat top to it; it is rather a low rail, with a wide flanch at the bottom, and a narrow rib between the top and the flanch, and that was to be laid on longitudinal bearers. The other gentlemen recommended that the rails should be made about 75 pounds per yard, (these are called the H rails,) and fixed in cast iron chairs with wooden keys. The Directors of the Greenwich Railway Company did not think proper to take upon themselves to decide which of those rails should be laid down, and they sent the reports that had been made to them, to witness (of course not putting the names of the engineers to the reports, but merely stating that they were the reports of their engineers), and requested an opinion as to which of these methods they ought to adopt. Advised them to adopt neither of the rails, as the Croydon rail seemed (that is the light rail, and the light longitudinal bearer,) altogether too weak, and the other was not so well adapted for a viaduct as it would be if laid on longitudinal bearers, but a stronger rail; therefore recommended them, instead of making use of a cross sleeper, with a 75 lb. rail, to make use of a bridge rail of 80 lb. per yard, which had got a wide flanch at the bottom. The rail was about 2¾ inches wide at the top. The flanch was half-an-inch thick, and the outside width of the flanch was six inches, and each of those sides was three-quarters thick; these rails were screwed to the timber; screw pins went through the longitudinal timbers, and underneath these were bars into which the screw-pins were screwed. By placing an auger-spanner on the top of the pins, the rails can be screwed down most securely. The rail laid down on the viaduct of the Brighton Railway was found to answer so well that witness recommended its adoption to the Greenwich Railway, and those rails are now laid down there. The nut keeps its hold and will run back, because it can at any time be screwed up; they have nothing to do but to apply an auger-spanner on it. Is laying down a railway from Hastings to Lewes, and likewise from the Chichester line, from Shoreham to Chichester, with rails of that description, but on cross bearers with this addition, that to each of them, at the joints, there is a wrought-iron plate into which the two rails slip. There is a wrought-iron plate about 10 inches long, turned up on the edges, so as to form grooves; the two rails come together into this wrought-iron plate; the rails cannot separate, and of course that part which turns down on the upper flanch of the rail keeps the one rail from rising above the other. In laying down these rails on the Greenwich Railway, we had no provision of that sort, and consequently they are liable in some degree to rise one above the other, unless the screws are kept tight: but even if the screws are all slack where these wrought-iron joint plates are used, they cannot rise one above the other. The rails were laid on cross sleepers; did not use the screw-pins at all, but merely a parallel bolt five-eighths of an inch in diameter, which holds better than screws or any other contrivance. We bore a hole half an inch in diameter, and then drive in the bolt: in fact, they hold so very fast, that in endeavoring to get them out sometimes on the Brighton Railway when a chair has broken, we have had to bend the pin backwards and forwards considerably before we could pull it out.

The velocity of the express trains on the Brighton is about 34 miles an hour, with one stoppage at Red Hill. There is very little oscillation if the road is in good order. Outside cylinders do not produce any yawing motion, it is impossible any such motion can be produced, unless there is a play in the framing itself. Considers the outside cylinders to be very much preferable to the inside, and they run a great deal steadier.

Mr. Henry Pringle Bruyeres: Is superintendent of the London and Birmingham Railway, and controls the general arrangements both of passengers and goods. Average speed of express trains on London and Birmingham line between station and station, exclusive of stoppages, rather more than 40 miles an hour, making no allowance for slacking and regaining speed. Including the stoppages at stations, the speed is 37 miles an hour. Does not think the greatest speed at any time exceeds 45 miles an hour for any distance. Passenger carriages on London and Birmingham line greatly improved. The improvement in the first class carriages is, as respects the construction, making the under framework stronger, and making it solid instead of open, as it was originally; in point of comfort to the passengers, in making the carriages larger altogether; each compartment being longer, to give more room for the legs, and higher. The carriages the company now build are in size proportionate to those on the Great Western Railway, with the exception that they may be three or four inches less in height. The reason of having them less in height is to allow of the luggage being conveyed on the roof; however, ample room is given, even for a tall person with his hat on inside. The luggage placed upon the tops of the carriages is principally "through" luggage, belonging to passengers that are going a long distance, so that when they arrive at the end of their journey, instead of having to seek their luggage at the forward part of the train, it is over their heads, and if they can only divest themselves of the idea that they are in a crowd upon their arrival, and remain stationary on getting out of the carriage, they will find their luggage immediately before them. All inside cylinders, and only one six-wheeled engine. The Company are now building six-wheeled engines. The engine and tender are tightly screwed together. Probable expense of London and Birmingham goods wagons into loose boxes for transfer on to broad gauge about, £50 per wagon. The London and Birmingham line now so consolidated, that the rains have little effect upon it; subsidence of the ballast does not take place upon the embankments.

The area of the Rugby Station is about 12 acres, including the portion used by the Midland Railway, as well as the London and Birmingham.

Dimensions of old and of new carriages.—They consist of three compartments, holding six persons each; the old carriage was in length, that is between the persons, face to face, 4 feet 11; the new are 5 feet 9, being an increase of 10 inches; the width of the old carriage was 6 feet, and the new is 6 feet 6, giving 2 inches more in width to each seat. The height of the old carriage was 5 feet, and the new ones are 5 feet 7, giving an extra height of 7 inches, that is between the floor and the ceiling, and taking it at the centre of the ceiling: the roof is curved about two inches, and is 5 feet 5 at the two sides. The outside length of the old carriages was 15 feet 6, and of the new are 17 feet 6. That is the entire body. The width was 6 feet 6 in the old, and is 7 feet in the new. The height, allowing for the curve mentioned before, would be 5 feet 2 the old, and 5 feet 8 the new. The total height above the rail of the top of the carriage is 8 feet 9 the old, and 8 feet 10 the new. The additional height inside has been obtained by lowering the floor.

At present, if the Great Western Company require engines from the North of England, when not carried by water, they come up upon the London and Birmingham, and are transferred from Euston-square to Paddington, and run down the Great Western line. This has frequently been the case; they are brought up on trucks. The comparative dead and nett weight carried by the down express train for the month of August, 1845, is as follows: number of passengers, 1613; carriages, including luggage van, 132; weight of passengers at ten to a ton, 161 tons; weight of carriages, 556 tons.

Colonel George Landmann: Was engineer of the London and Greenwich Railway and the projector of that scheme. When the line was constructed, used a very light rail, of 50 pounds to the yard. Subsequently changed those rails for others of a heavier description, weighing 85 pounds; the first rails did not reverse; the present rails do reverse; the new part is upon the Great Western principle, upon longitudinal sleepers; in the first instance, used stone blocks, which were afterwards changed to transverse sleepers. The widened portion of the line, from London to the separation of the Croydon, and the portion from Deptford to Greenwich, originally laid upon longitudinal sleepers, with the same form of rail as the Great Western; that rail was 50 pounds to the yard, whilst the Great Western was 43 pounds. The longitudinal sleepers between Deptford and Greenwich are 12 inches wide by 6½ deep; those upon the widened part are the whole size of the baulk; 12 and 13 inches, with ties across the same depth, to preserve the gauge. The longitudinal sleepers of the Greenwich line, extending from Deptford to Greenwich, rest upon transverse sleepers, 10 inches by 6, by 6 to 7 feet long, and placed at distances of about 4 feet apart, and to which the longitudinal sleepers are spiked; these sleepers were all Kyanized, and, as far as witness has been able to discover, are still quite sound. With longitudinal sleepers a lighter rail might be used than would be required where there is a space between the supports; and if the ground be properly made at first under longitudinal sleepers, is of opinion that that would be the best mode of constructing a line; objects to the mode adopted under Mr. Rastrick's direction of laying the rails upon the widened portion of the Greenwich Railway. Witness's design was to have transverse sleepers, with the longitudinal sleepers upon them; it now entirely rests bedded upon earth; if it had had fixed points to rest upon, it would have been much more secure. Should rely entirely upon the bearing upon the transverse sleepers. It is not found too elastic upon the Great Western; the longitudinal sleeper is only 7 inches thick; they have no transverse sleepers. The engines on the Greenwich line weigh about 14 tons with the water. Some are six and some are four-wheeled engines; four-wheeled engines are going out of use as fast as they become destroyed; upon a portion of the line (the Brighton and South Eastern line) they run with much heavier engines, weighing 16 or 17 tons.

Charles Vignoles, Esq.: Laid out the Eastern Counties with Mr. Braithwaite, but that gentleman executed it; a question as to the gauge arose; was then very desirous of making the gauge wide; Mr. Braithwaite's view of having a 5-feet gauge was adopted; should have preferred a 6-feet gauge. Intended the Dublin and Kingstown Railway to have been a 6-feet gauge; but the Directors overruled his opinion, on the plea that so short a line might, if necessary, have its gauge altered without inconvenience; they had to obtain all their first carriages and engines from England, where 4 feet 8½ was the prevailing gauge, and they were very unwilling to depart from it: he has been consulted in laying out many principal lines, and also on the gauges of many; the Edinburgh and Glasgow was laid out, though not executed, by him; as it was likely to connect ultimately with lines coming from the south, on the 4 feet 8½ principle, that gauge was adopted; some Scotch lines already executed are on rather a narrow gauge; thinks one coal line, the Forfar, was 5 feet 6 inches; but the general feeling was strong that connexion with south lines should be kept in view; most of the lines mentioned were previously to the introduction of the broad gauge by Mr. Brunel. On the Continent, as the engines and carriages were obtained from England, they were unwilling to deviate from the fixed rule; the first railway in Brunswick was about 30 miles to the foot of the Hartz mountains, and the English gauge was adopted; the latest large operation of his on the Continent was laying out the Wirtemburg railways; there the question of gauge was greatly discussed, and is not yet settled; they are intended to unite the railways in Baden, which run parallel to the

Rhine, and those in Bavaria, which run from the Danube; the gauge of the Baden railways is 5 feet, or 5 feet 6, and that of the Bavarian 4 feet 8½; under all the circumstances, he recommended that 4 feet 8½ should be adopted; as all the railways in connexion with Bavaria, and all the Saxon and Austrian, are 4 feet 8½, and as a great transit trade was coming from those countries, he considered that the larger amount of traffic would be from those of 4 feet 8½, and that the length of rail on the Baden side, next the Rhine, would be short in comparison; he thought Baden would ultimately be obliged to change, and bring it to the gauge of the others on the Continent; however, Baden and Bavaria persist in not changing, and it is a question at what point the transit shall take place, whether on the eastern or western frontiers of Wirtemburg; thinks the probability is, that they will ultimately adopt the 4 feet 8½ gauge throughout Wirtemburg.

As to the cost of the carriage frame, thinks it would increase as the squares of the gauges, but with a certain additional amount of accommodation; one great advantage of a large carriage is, that you get less gross weight in proportion to the nett; does not know whether that has been realized in practice, but thinks it ought to be so. As regards increase of speed, does not think on that alone the Great Western has an advantage; the trains travel very fast on it, but much more is due to the gradients, which are very flat, than to the gauge; with respect to economy of working, the expense on the Great Western and the London and Birmingham is as near as possible the same. With respect to safety, as far as it is connected with steadiness, is quite satisfied that at very high velocities the trains travel more steadily on the Great Western than on the London and Birmingham, taking the gradients as they occur. In the abstract, is quite satisfied there is greater steadiness of motion on the broad gauge at high velocities. If the road happens to be out of order, or the springs of a carriage stiff, or if it is not loaded or over loaded, or a little slack in the coupling up, or too tight—all those will affect it particularly at high velocities; has not made a series of experiments, but is quite satisfied that it is steadier with the broad than with the narrow gauge at a high velocity. It is impossible to write on the London and Birmingham at a high speed; he could read in their express trains very well where the road was in good order, but when bad could not.

Used to be, and is still, very partial to the longitudinal sleeper; but some facts have come to his knowledge to shake his views, in particular, on a foggy morning on the North Union, when an engine comes to the longitudinal sleepers she invariably slips, which does not take place on the cross-sleepers; cannot account for it. It may be owing to a dampness that remains on the longitudinal sleepers which may impart to the rail a moisture which converts dust to mud, and produces greasiness. The soil is chiefly sand, with probably a little clay in that portion of it; but still, wherever the longitudinal sleepers are, the engine has a great tendency to slip. Has often calculated the relative cost of laying rails on the longitudinal and cross-sleepers; it was very much in favor of the longitudinal in the first instance, where a slighter baulk was used; but as it is now necessary to have the whole or at all events a three-quarter baulk, the balance is against the longitudinal as the more expensive; a very heavy rail, with a cross-sleeper without the chair, answers very well, and is the most economical mode. The first Liverpool and Manchester rails were 35 lb., and the 42 lb. rail on the Dublin and Kingstown is still in use. On the lower part of the North Union the 42 lb. rails have been taken up and replaced by 63 lb. On that line the passenger trains are light, but the merchandize and coal excessively heavy. The lengths of bearings are 3 feet 9 inches and 4 feet; four to a rail.

Should the Grand Junction Company alter to the broad gauge, it would be practicable to alter the North Union too, as the bridges and tunnels are sufficient for the purpose; none of the bridges are less than 30 feet span, and those of the Great Western are not more. His practice is to make bridges about 30 feet. The tunnels are about 27 feet.

On the Midland Counties the bridges are all 30 feet; the viaduct at Rugby is 27, which would admit of the broad gauge by corbelling out the parapet; the Great Ribble Bridge on the North Union is 27 or 28 feet wide, and the tunnel into Preston, the only one, is nearly 30 feet. With less than 30 feet there would not be room for a man with safety; it would be better to have recesses built in the tunnels. Thinks, by a judicious system of transfer of bodies, the packing and unpacking at Gloucester might be avoided. The passenger carriage-bodies may be transferred, as at Rouen, to the frame of the railway carriage, without any risk or difficulty. Has ridden in one of those carriages, and been lifted up with it, without any practical inconvenience. It is bolted down, and is as perfect as if it were the railway carriage itself. A carriage put together in that way is as strong as a usual one, in case of collision; it is strong enough to be lifted, and, being required for the road, is stronger than the railway carriage. Considers the 7-feet gauge wider than is necessary; the wider the gauge, the more the effects of curve are felt; does not think the gradient at all enters into the question. The Great Western has large driving-wheels, not with regard to gauge, but velocity; there is no necessary connexion between the diameter of the wheel and the gauge. Would not adopt the 7-feet wheel on the narrow gauge; but that is a proof that it must be steadier on the broad. A great number of things were proposed in adopting the broad gauge, which have not yet been carried out with effect. Were he the engineer of a broad gauge line, should avail himself of the increased space to make engines more powerful. The necessity of increasing the engines is every day apparent, and to have engines so far above the work that there can be no question about their power. The driving-wheel of the engine will regulate the velocity; one of the Great Western engines, with the large driving-wheel, would give the same amount of speed, whether on the broad or the narrow gauge. The diameter of the driving-wheel is quite a different question from that of gauge, except as regards the increased steadiness arising from the wider gauge.

(To be continued.)

Cost of Railways in Great Britain.

The following is the average cost per mile of some of the principal lines in this country :—

Arbroath and Forfar,	£9,214
Chester and Birkenhead,	34,198
Dublin and Drogheda,	15,652
Dublin and Kingstown,	59,122
Dundee and Arbroath,	8,570
Durham and Sunderland,	14,281
Edinburgh and Glasgow,	35,024
Eastern Counties & North-Eastern,	46,355
Glasgow, Kilmarnock, and Ayr,	20,607
Glasgow and Greenock,	35,451
Gravesend and Rochester,	13,333
Great Western,	43,885
Hartlepool,	26,600
London and Birmingham,	38,400
London and Blackwall,	287,678
London and Brighton,	56,981
London and Croydon,	80,400
London and S.-Western,	£28,004
Manchester, Bolton & Bury	70,000
Manchester & Birmingham	61,624
Manchester and Leeds,	64,582
Midland,	30,949
Newcastle, Darlington, and Brandling,	22,992
Newcastle and Carlisle,	17,837
Newcastle and N. Shields,	44,233
Norfolk,	13,150
North Union and Bolton & Preston,	27,799
Preston and Wyre,	22,261
Sheffield and Manchester,	48,543
South-Eastern,	44,412
Taff-Vale,	21,610
Ulster,	14,334
York and N. Midland, &c.,	25,924

Min. Jour.

Government Engineers in France.

The corps of engineers of Ponts et Chausses, (roads, bridges and public works,) now on Full pay in France, consist of 9 inspectors-general, 23 divisionary inspectors, 213 chief engineers 387, ordinary ditto, 66 candidate engineers, and 27 students of the first class—making 722, to which may be added 109 engineers of mines—making 831.

Ibid.

Reason for the original adoption of the usual Gauge for Railways.

While we are on the subject of the gauges, we may be permitted to mention a fact or two. It is not, as has been asserted, an arbitrary and random measure which was taken for the gauge of railways. The breadth of the gauge, as Mr. George Stephenson admitted to us some time ago, when we mentioned it to him, was taken from the breadth of the wheels of carriages on common roads. A breadth of five feet from the outside of the bottom of one wheel to that of the other, was the standard breadth for carriages on turnpike-roads, and that had been determined from long experience as the best breadth for easy draught to horses. In some parts of the kingdom there was, indeed, a rather narrower, as we have observed in the lower parts of Devonshire; but, generally, five feet was admitted to be the standard.

We have been assured, that wider wheels produced a sensibly heavier draught, while, from circumstances of convenience and comfort to the horses, they could not well have a narrower. One reason why they should all have the same breadth doubtless was, that the wheels should be able to keep in the same ruts—a measure of consequence heretofore, when the roads were bad and worn into tracks.

Lond. Railway Mag.

Railway Bills.

The following is an account of all railway bills which have been reported to the House of Commons during the present session, with a statement of the *maximum* rates of charges and fares for goods and passengers, respectively authorized by such bills. The document contains 138 bills, made up to the 29th of May. From an examination, it appears that, in the first class the highest sum to be charged per mile for passengers is to be 3½d., and the lowest in the same class 2d.; whilst in the third class the charge is to be 1d. and 1½d. In the second class the charge in some instances is to be 1½d., and in others 2d. a mile. On some of the railways, when the speed is more than 25 miles per hour, an additional ½d. is allowed in the first class. The charges in some of the bills, reported during the present session, are to have reference to former acts. In the Great Western bill, no provision has been made with regard to charges of any description.

Min. Jour.

Cornish Engines.

The number of pumping engines reported this month is 29. They have consumed 2271 tons of coal: and lifted 24 million tons of water 10 fathoms high. The average duty of the whole is, therefore, 53,000,000 lbs., lifted one foot high by the consumption of a bushel of coal. Average consumption per horse power per hour, 4·011 lbs.—"*Lean's Engine Reporter*," *July* 13*th.*

AMERICAN PATENTS.

List of American Patents which issued in the month of December, 1845,—*with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in the Water Ram for raising water ;* Erastus W. Ellsworth, East Windsor, Connecticut, December 6.

Claim.—"What I claim as my invention and desire to secure by letters patent, consists in a peculiar manner of working the water ram in combination with the syphon, by the use of a chamber of rarified air, for the purpose of causing the escape-water to flow down the longer leg of the syphon in a continuous stream; also, in the use of channels in the packing of the joints, supplied with water from the air vessel of the ram, for the purpose of excluding, completely and with certainty, the external air from the syphon; also, in the fixtures herein described for the setting in motion and regulating the quantity of water consumed by the ram."

This is an improvement on Montgolfier's water ram, the nature of which is sufficiently apparent to need no further exemplification.

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2. For an *Improvement in Pressing Glass in Moulds;* Joseph Magoun, East Cambridge, Massachusetts, December 6.

Claim.—"Having thus explained my invention, I shall claim the plate as combined with the sliding frame for the purpose of receiving the cap plate of any mould of various moulds, as described; also the making the whole frame, plate, toggles, lever, and bars, and rest block of the toggles, adjustable with respect to the mould or bed plates upon which it is placed, in the manner as above described."

The plate (M) is the bed of the press, so formed and connected with the slide of the follower of the press as to admit of the introduction and removal of any mould, that various moulds may be used in succession. The moulds have a flanch at the top, which rests on the bed plate (M.)

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3. For *Improvements in the Portable Cooking Furnace;* C. L. H. Webb, Lockport, New York, December 6.

Claim.—"I claim the quadrangular, inverted, pyramidal form of the grate in combination with the side doors, hinged at the bottom and opening downwards, to answer the purpose of hearths, that the whole surface of the fire at the sides may be presented, and the rays therefrom may be cast on to instead of over the article to be cooked or heated on the hearths, as herein described. And, finally, I claim the method of sustaining the side doors when open, by means of the jointed and sliding links, as herein described."

The doors are prevented from falling by being connected with the case by means of a joint and slide link. This link is jointed at one end with the door, and the other is provided with a long slot which slides on a stud pin projecting from the case, so that in closing the door the long slot slides on the stud pin, and when the door is open to a horizontal position the end of the slot rests against the stud pin.

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4. For an *Improvement in Cooking Stoves;* Samuel Pierce, Peekskill, New York, December 6.

Claim.—"I claim the arrangement of the parts by which I supply the fire with heated air; said arrangement consisting mainly of the sliding register and the plate in front of which the air must descend on its passage to the grate bars. The heating of the admitted air has been attempted under other arrangements, and I limit my claim in this particular, therefore, to the special combination of parts by which I attain this end."

5. For *Improvements in the Corn Sheller;* Thomas D. Burrall, Geneva, New York, December 6.

Claim.—"In the machine described, I claim making the *concave plate or disk* with a concave face and circular opening, provided with a lever and upper lip for the discharge of the cobs, in combination with the sheller and with the shell or bottom, and also the door or valve in the side for the broken cobs, &c.; and also the cylindrical *hopper and spring in combination with the feeder,* as herein described."

In this machine, the corn is shelled by teeth on the face of an iron disk, which works against a concave plate so curved as to form a spout at the top for the discharge of the cobs; the shelled corn being discharged at the bottom. There is a hole in the back plate with a valve for the discharge of broken cobs which are not carried out of the spout. The hopper is cylindrical, and provided with a spring which presses the cobs against the teeth of the feeding wheel, by which the ears are delivered regularly to the sheller.

6. For an *Improvement in the Furnace for heating air;* Ebenezer Barrows, New York, December 11.

Claim.—"Having thus fully described the nature of my improvements in the air-heating furnace, what I claim therein as new and desire to secure by letters patent, is combining with such a furnace the evaporating and radiating vessels or vessel M, arranged, combined, and operating substantially in the manner and for the purpose herein made known."

This furnace is combined with an evaporating apparatus which supplies to the heated air the required quantity of moisture. The pipe which conducts off the gaseous products of combustion is connected with branch pipes which carry these hot gases to chambers surrounding the vessel (M) to evaporate water contained in them, and from these chambers the draught is conducted to the chimney. By means of a damper, the draught from the furnace can be carried around these vessels, or directly out. The vapor thus generated mingles and circulates with the heated air from the furnace.

7. For *Improvements in the Cotton Gin;* Theodore Ely, New York, December 11.

The patentee says:—"Much difficulty has been experienced in ginning the long staple cotton, from the tendency of cutting or breaking and heating the fibres, results so injurious to the staple—the value of which depends on the length and entirely and perfectly natural condition of the fibres. The most general mode which has been resorted to for the effectual ginning of the long staple cotton is the use of rollers, which draw the fibres and separate them from the seeds. These rollers have been made of various substances, such as metal, wood, cork, stone, &c., with their surfaces smooth, fluted, indented, &c.; but all these, so far as I am informed, have failed in giving satisfactory results. Those made of wood have so far been the most successful, but in a very short time they become rough, and injure the staple; and have, therefore, frequently to be renewed. And even these only succeed when the cotton is fed in by the hand of an attendant, who, with his fingers, properly loosens and distributes the pods. The metal rollers, in consequence of the smoothness of metal surfaces have to be fluted, or otherwise indented, that they may take sufficient hold of the fibres to draw them through, and as these, thus formed, tend at times to draw in too much cotton at once, together with the seeds, the two rollers must be pressed together by extra force, such as weights or springs, which additional pressure tends to heat the rollers, and thus to injure the staple Rollers made of other substances have, for like and other causes not necessary to enumerate, failed to produce the results anticipated and required.

"All the kinds of rollers which have been used tend to 'lap the cotton,' as it is termed, that is, the fibres adhere to and are wound around the rollers. These defects in the operation of roller gins arise from the fact that the cotton is not properly loosened preparatory to being submitted to the action of the rollers, and because these (the rollers) have not been made so as to avoid heating and griping the fibres, and from their arrangement and action on each other the surfaces which act on the fibres are so brought together as necessarily to injure each other. The object of my improvements is to avoid all these defects, and they consist in the following devices, viz :—in the employment of a toothed roller which takes the cotton from a feeding board or apron, and carries it around, properly distributed, to the action of a rotating beater, which whips it, and loosens the pods, and blows them in regular quantities down an inclined board to the bight of the two separating or ginning rollers, which are made slightly fluted or grooved in lines parallel with their axes, the better to catch and hold the fibres; but to prevent the bad tendency which has always been experienced in the use of fluted metallic rollers, the flutes or grooves do not extend their whole length, the ends being left perfectly smooth for a short distance, so that the edges of the flutes of the one shall not enter the recesses of the other, or catch and cut the fibres, this being prevented by the smooth surfaces at the ends, which roll on each other. And the tendency to cut, and tear, and injure the fibres by the heating of the rollers is also avoided, by dispensing with the additional pressure, heretofore used, so long as the proper quantity of cotton is presented to the action of the rollers, and these do not draw in too much; but when this does take place, then their bearings, or the sliding boxes in which they work, are brought into contact with weighted levers, springs, or other analogous device, properly gauged, to bring them into action before the rollers shall have been sufficiently separated to permit the entrance of seeds. The rollers are relieved of this additional pressure the moment the overcharge of cotton ceases, for then the weighted levers or springs are arrested by the gauges.

"And the lapping of the cotton around the rollers is avoided by means of additional rollers, placed in front of, and in contact with, the ginning rollers; the surfaces of the two sets, where they come in contact with each other, moving in opposite directions, to strip the ginning rollers of any fibres which may have a tendency to adhere to them.

"These improvements I have effectually tested by a long series of experiments, and the cotton is not only ginned with greater rapidity, but the fibres are delivered in as perfect a condition as if separated by hand."

Claim.—"What I claim as my invention and desire to secure by letters patent, is making the ends of the fluted, grooved, or ridged ginning rollers, without the flutes, grooves, or ridges, so that they shall run on each other, and thus prevent the injurious action of their parts operating on each other and on the fibres of the cotton, as described.

"I claim the rotating, stripping, or cleaning rollers, in combination with the ginning rollers, for the purpose and in the manner substantially as herein described.

"I also claim the feeding roller and beater or blower, in combination with the ginning rollers, for the purpose of loosening the cotton, and presenting it to the action of the ginning rollers, as described.

"And, finally, I claim the beater or blower, in combination with the ginning rollers, for the purpose and in the manner described."

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8. For *Improvements in the Furnace for heating apartments;* Henry Kalussowski and J. P. Wierzbicki, New York, December 11.

Claim.—"Having thus fully described the manner in which we construct and arrange the various parts of our apparatus for heating apartments, and shown the operation of the same, what we claim therein as new, and desire to secure by letters patent, is the manner of combining and arranging the radiating air heaters so that the air to be heated by them shall ascend on both sides of them, or shell, or case, or casing of brickwork, performing the same office, as set forth; and the fire-place above the top-plate being so enclosed by a suitable plate, or by masonry, as to cause the whole of the air heated by the radiators to pass into the apartment, in the manner described.

"We do not claim the use of a radiator or radiators, like those described, as new, such having been before used; but we limit our claim to that arrangement of them by which they are made to heat an ascending current of air on each of their sides, for the purpose herein fully made known.

"We do not intend, however, by this claim, to limit ourselves to the particular form of either of the parts of the said apparatus, but to vary these as we may think proper, whilst we attain the same ends by an arrangement of parts substantially the same."

9. For a method of *Combining Canals and Railroads;* Samuel S. Walley, Charlestown, Pennsylvania, December 11.

Claim.—"Having thus fully described the manner in which I combine the railway and canal for the purpose of transportation, what I claim therein as new, and desire to secure by letters patent, is the combining of a railroad and canal by laying rails on the bottom of the canal which is to be used, and the rails submerged in its content of water; by the employment of a locomotive engine and of car-boats, which, whilst their wheels are sustained upon the rails, are to be buoyed up by the water, as set forth.

"I claim the adapting of the car-boats and the lock chamber to each other, so that when the former are contained within the latter they shall operate as lock gates by preventing, or nearly preventing, the passage of water, thereby allowing the lock gates to be opened and the train to pass through the lock with little loss of water, upon the principle and substantially in the manner herein described."

10. For an *Improvement in the method of Constructing the Sails of Vessels;* James Maull, Philadelphia, Pennsylvania, December 11.

Claim.—"What I claim as my invention and desire to secure by letters patent, is cutting and making the sails of all kinds of vessels with the warp of the cloth and the seams in a horizontal direction, for the purpose and in the manner described."

11. For a *Filter for Inkstands;* Walter Hunt, New York, December 11.

Claim.—"My claims in the above described invention are confined to the filter tube, in combination with the funnel, plunger, spring, and perforated bottom, arranged substantially in the manner and for the purposes described."

The filter tube extends from the funnel-shaped ink tube at the top to within a short distance of the bottom, to permit the ink to rise through a hole in a cork at the bottom. Above this cork, the ink has to filter through a sponge to supply the chamber above. The lower end of the funnel-shaped ink tube is provided with a small funnel-shaped piece, which is forced up by a spiral spring, and provided with an aperture filled with sponge. When the pen is dipped, the part last described is borne down to admit ink from the filter tube, the sponge in the dipping tube permitting the ink to flow back, at the same time excluding the air.

12. For an *Improvement in Gates for Fences, &c.;* Andrew Hood, New York, December 16.

The patentee says:—"The principle of my invention consists in hanging a swinging gate on a central axis when combined with a fence arranged around it, with a carriage or other way on opposite sides, so that the gate closes against either side of these gateways the gateways being open on each side for the admission of carriages, horses, &c., within the fence. And also in providing the gate with projecting handles, for operating two latches or bolts which fasten it, so that the rider in passing along can reach the handle and turn the gate against the other side of the carriage way without the necessity of dismounting, as is the case in the present mode of construction."

Claim.—"I do not claim as my invention hanging a gate on a central axis, so as to open in either direction and close without a return movement, as this has long since been effected; but what I claim as my invention and desire to secure by letters patent, is such a gate hung and turned on a central axis in combination with the fence arranged around the axis of the gate, and provided with two carriage or other ways on opposite sides, as herein described, and for the purpose specified."

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13. For an *Improvement in the Power Loom;* Robert P. Cunningham, Abington, Connecticut, December 16.

In this loom, the two shuttle cams are so formed as to move back the pickers as the shuttle approaches them, for the purpose of gradually arresting it; and to adapt this mode of making the cams to looms that have sliding shuttle-boxes to change the colors, the cams are made with a slight depression to draw back the pickers from the ends of the shuttle, that the shuttle-boxes may be shifted without the shuttles hanging on to the pickers."

Claim.—"What I claim as my invention and desire to secure by letters patent, is forming the face of the shuttle cams with a depression, as herein described, to permit the picker to be moved back clear of the shuttle point, after the shuttle has been arrested, and before the shuttle boxes are shifted, as herein described."

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14. For an *Improvement in the Bathing Apparatus;* Wm. G. Young, assigned to A. H. Reiss, Baltimore, Maryland, December 16.

Claim.—"Having described my improvement, what I claim as my invention, and desire to secure by letters patent, is a boiler surrounding a furnace, as herein described, in combination with a flue ascending and returning in an apartment at the foot of the bath, as set forth."

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15. For an *Improvement in the Apparatus for the Manufacture of Sugar;* Francis Duplessis, Plaquemines, Louisiana, December 16.

Claim.—"I am aware that, for cooking and other purposes, kettles have been set directly into a steam boiler, so as to have the steam in the boiler act directly against their bottoms, but this has always been limited to one kettle for each boiler, which, if applied to the manufacture of sugar, would require one boiler for each kettle in the series, presenting not only the objection of great cost in the original construction, but much labor in attendance, as well as the important difficulty of keeping up an equal temperature under all the kettles at the same time, which is frequently required; and, therefore, I do not wish to claim simply letting a single kettle into a steam boiler, to have the steam act directly on the bottom thereof, nor do I wish to claim simply the insertion of a series of kettles in one boiler for general uses; but what I do claim as my invention and desire to secure by letters patent, is the arrangement of a series of kettles for evaporating saccharine juices and sirups in the manufacture of sugar, on the top of, and let into, one steam boiler, when any method is employed of regulating the temperature of the kettles—that is, reducing or increasing the temperature of a portion of the series without affecting the rest—substantially as described.

"I also claim arranging the series of evaporating kettles, let into the top of one steam boiler, to have them exposed directly to the action of steam within the boiler, in combination with the arrangement for heating the pans, for preparing the saccharine juice, by means of steam conducted from the boiler into the double bottoms of the pans, as described.

"And I also claim dividing the boiler into two or more compartments by a partition or partitions, provided with a valve, in combination with the arrangement of kettles let into the boiler, for the purpose of regulating the temperature, as described."

16. For an *Improvement in Cooking Ranges;* Wm. Beebe, New York, December 16.

Claim.—"I do not claim to have invented the mode of causing a circulation of water between a principal boiler or water back and the boiler by the pipes, as this is in common use; neither do I claim to have invented the arrangement or application of the pipes to the circulation of hot water within a building, except as hereinafter stated; but I do claim as new, and of my own invention—

"1st. I do not claim to have invented or introduced the pipe to lead in the supply of water from any competent head, but I do claim the mode described of forming this pipe with perforations or orifices near the boiler head, for the purpose of securing the boiler against accidental injury, in the manner and with the effects described and set forth.

"2d. I do not claim to have invented the hollow plug of the cock, but I do claim the mode of making and fitting the said plug with the short slots, to draw hot water by the bib, in combination with the long slot, at right angles with the two former, for the purpose of maintaining a circulation of hot water in the pipes, or suspending the same by turning the blank part of the plug to the pipes, substantially as the same are described and shown."

17. For an *Improvement in Water Tables for Doors;* A. S. Pelton, Clinton, Connecticut, December 16.

Claim.—"Having thus fully set forth the manner in which I arrange and operate a water table or weather strip at the bottoms of doors, what I claim therein as new, and desire to secure by letters patent, is the particular manner in which I have combined the respective parts, as described; that is to say, the water table being forced down by the action of the head of the rod on the inclined plane, through the intervention of the levers, and being raised by the spiral springs when the door is opened; and the necessary adjustments being also effected by the aid of the screw nuts and spiral springs, substantially in the manner described."

18. For a method of *Restoring the Fullness or Roundness to the Cheeks;* John Allen, Cincinnati, Ohio, December 16.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of restoring hollow cheeks to their natural contour and rotundity by means of metallic bulbs, formed, fitted to, and secured in the mouth, substantially in the manner set forth, or by any other attachment between the jaw-bones and the cheek."

10. For an *Improvement in the method of Manufacturing Chewing Tobacco;* Henry Moore, Reedsville, North Carolina, December 16.

The patentee says, "Instead of pressing the lumps of tobacco in formers, as generally practised, I lay or pile the leaves of tobacco one above another, on a bed of wood or metal, and within a movable frame which surrounds the bed—the fine covering leaves being placed at top and bottom; then the frame is removed, and another frame put on top of the tobacco, and the whole submitted to the action of a powerful press, by which the whole mass of tobacco is pressed and divided into any required number of 'lumps,' and the covering leaves drawn tight and smooth over the surface."

Claim.—"What I claim as new, and desire to secure by letters patent, is the method of forming tobacco 'lumps' by means of the frame and series of blades, arranged and formed substantially as herein described, in combination with the bed, whereby I save much labor in arranging the tobacco leaves, &c., and I am enabled to form and press a large number of 'lumps' at one operation, to lay the covering smooth and even, give a more perfect form, and discharge them from the moulds in which they have been formed with greater facility than by the old method."

20. For an *Improvement in the method of attaching Printing Types to a Cylinder;* Richard Hemming, Boston, Massachusetts, December 16.

The patentee says,—"This invention consists simply in making the types with a recess in one face of the body or shank, to receive a rule, or strip of metal, which is laid in after a whole range of types has been set up; the ends of the rule projecting beyond the range sufficiently to be secured by a slide or cap plate attached to the cylinder. From this it will be obvious that no one type can rise above the range without cutting off the rule, a number of them cannot rise in a curve without bending the rule, and the whole range cannot rise because the ends of the rule for each range are held down by the slides or cap plates."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the method of retaining types in their proper relative positions on a cylindrical bed by means of rules or strips of metal, or other appropriate substance, fitting into recesses made for that purpose in the body or stem of types, substantially in the manner described."

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21. For *Improvements in Fire Engines;* Ernest Marx, New York, December 20.

The object is to use the hind wheels of the carriage as fly wheels to the engine when at work by lifting the back part of the engine so as to relieve the wheels; but the claim is drawn up in such manner that it cannot be understood without the drawings.

The first section of the claim is limited to the arrangement of parts for lifting the hind part of the carriage and chocking the front wheels, and the second section is limited to the arrangement and combination of parts for connecting the working parts of the engine with the hind wheels to make them operate as fly wheels.

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22. For *Improvements in the Steam Engine;* John Ericsson, New York, December 20.

In this there are two engines connected with, and operating a crank shaft with the cranks at right angles. The steam is admitted directly from the boiler to only one of the cylinders, and when the piston in this has made half its stroke the communication with the boiler is closed, and a communication with the other cylinder opened, that the steam may act expansively in both, driving the two pistons in the same direction, until the piston in the first cylinder has completed its stroke, then the communication between the two is closed, that the steam in the second may continue to operate by expansion while the piston in the first makes its return half stroke by the force of steam directly from the boiler like that above described on the other side. The two engines are on the condensing principle.

The exhaust pipe of the first engine communicates with a heater as well as with a condenser, and this pipe is provided with a valve which establishes a momentary communication between the cylinder and the heater, and when this connexion is closed the steam passes to the condenser.

Claim.—"I do not claim as my invention the pistons, valves, or any other known part of the engine, hereinbefore described, nor do I claim the passing the steam from one cylinder to another, that having been done by Wolf, and others; but I claim as my invention, and desire to secure by letters patent, the connecting the pistons of the two cylinders to cranks placed at right angles, in combination with the admitting the steam directly from the boiler into one cylinder only, and the working of the steam expansively in said cylinder, together with the employing the steam to act simultaneously on both pistons during half the stroke as herein described, by opening a communication alternately, and keeping the same open during only half the stroke between the two cylinders, whilst at all times a vacuum is kept up during the entire stroke in both cylinders, on the opposite sides of each of the pistons to that on which the steam acts."

"And I also claim as my invention the momentary stoppage of the exhaust pipe of that cylinder, which receives the steam from the boiler into a receiver partially filled with tubes, through which the feed-water is passed on its way to the boiler, in the manner hereinbefore described."

23. For an *Improvement in Magnetic Telegraphs;* Ezra Cornell, Ithica, New York, December 20.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the new and improved mode, described, of arranging and adjusting metallic wires, or other conductors to electro-magnetic and galvanic telegraph instruments, by which instruments, at opposite extremities of the same, or of a single main wire, or located at distant points on the same main wire, or a single wire, may be kept in constant readiness for use, in conjunction with a galvanic battery, without the necessity of keeping the galvanic circuit closed, or the battery in action, when neither instrument is at work; and by which the battery is put out of action instantly on the ceasing of the motion of the instrument, and in like manner is put into action immediately on commencing the motion of an instrument, and avoiding the disadvantage heretofore experienced in what have been denominated *dependent* circuits, in the working of two or more telegraphic instruments over a single circuit of wire, or of wire and earth conjoined."

24. For an *Improvement in Riveting Pipes made of Sheet metal;* Jonathan Ball, New York, December 20.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the mode of holding the rivets in the holes by the use of the springs, in combination with the mandrel or the clamps, in the construction and application, as they are set forth in the accompanying specifications and drawings."

The metal is bent, having the two edges which are to lap some distance apart. The rivets are inserted in the holes, along one edge and held there by small clip springs. The pipe is then placed between two clamps and over a mandrel so as to have the heads of the rivets resting on it; the clamp is then closed which brings the holes on the other edge of the sheet over the rivets ready for the hammer of the workman—the spring clips having been removed before closing the clamps.

25. For *Improvements in the Cultivator;* Allen Eldred, Oppenheim, New York, December 20.

The patentee says,—"My invention consists in connecting the ploughs with the frame by means of iron sockets secured to the side of the side and centre pieces; and in jointing these sockets to the frame for the purpose of regulating the set of the ploughs to cut deeper or shallower; and in securing the front double tooth to the frame by inserting it in a mortise of sufficient length to receive a wedge front and back, projections being made on each side of the standard, that lie in recesses made for that purpose in the under face of the centre piece of the frame to act as journals, so that by driving the wedges front or back, the point of the double tooth may be elevated or depressed to cut deeper or shallower."

Claim.—"What I claim as my invention and desire to secure by letters patent, is jointing the sockets that receive the standards of the ploughs to the frame, as herein described, to admit of adjusting in a vertical as well as horizontal direction, as specified; and finally, I claim the method of adjusting the front double tooth by means of the enlarged mortise and wedges, in combination with journal projections on the standards, as described."

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26. For *Improvements in Machinery for working Ivory Comb Plates;* Calvin B. Rogers, Saybrook, Connecticut, December 20.

We are under the necessity of omitting the claims as they are wholly dependent on the drawings.

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27. For an *Improved Iron Truss for Ships;* John W. Wilson, Philadelphia, Pennsylvania, December 20.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the *relief truss,* attached to the truss hoop connecting it with the mast, to the arm, connecting it with the lever and the yard so as to permit the topmast to be lowered and raised any time at pleasure, through the relief truss, without unshipping the yard, or in anywise interfering with its motions, actions, uses, or any of its appurtenances."

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28. For an *Improvement in the machine for Double Seaming Tin Ware:* Daniel Newton, Louisville, Kentucky, December 20.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the turning of a double seam on the bottom of tin and copper ware, by the application of a bevel wheel on a shaft placed at right angles with the shaft on which the vessel revolves, in combination with the guide on which the same rests, in order to insure a perfect rotary motion of the vessel."

The article to be double seamed, is placed on a wheel at the end of a horizontal shaft, and guided and retained on it by a guide standard, and the double seaming is effected by a bevel wheel on a vertical stud pin, the bevel part of the wheel acting in connexion with the edge of the wheel that carries the article to make the seam.

29. For a *Machine for Beating and Cleaning Wire;* John J. Howe, Derby, Connecticut, December 26.

Claim.—"I claim as my invention, and wish to secure by letters patent, the combination, herein described, of parts which are designated herein, and marked in the drawings respectively, as follows, viz: the block or platform, the lifter, and the curb or pins 1 and 2; and I claim said combinations of the block, lifter, and curb, whether in combination with or without the guide."

The platform is a bed with a hole in the centre, and excavations to receive the spindle hub and radial bars of a lifter on which the wire is to be placed. This lifter is carried up gradually by a cam and then permitted to fall, to give the required jar or blow to the wire, which is retained on the lifter by a series of vertical rods projecting from the platform.—The lifter may receive a slight rotary motion by a guide.

30. For an *Improvement in the Machine for Turning Oar Handles;* Ezekiel Page, Barcelona, New York, December 26.

Claim.—"I therefore claim the said inclined rail and slide, as combined with the opening of the puppet head, the same being for the object as above set forth."

The inclined rail is permanent, and is for the purpose of giving the swell to the oar handle by acting on a slide rest, in a sliding puppet head, to reduce the opening through which the oar handle passes for the purpose of giving it the required form, the cutter which turns the handle being placed in the upper part of the hole, so that as the slide rest is elevated by the inclined rail, the space between the rest and cutter shall be reduced.

31. For *Improvements in the Camphine Lamp;* James Maclean, Philadelphia, Pennsylvania, December 26.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the use or substitution of tubes made of a material which is a non-conductor of heat, instead of the ordinary metallic tube, between which the wick works up and down, and also the protection of the non-conducting tubes by the cap or prolongation in metal.

"I do not claim any particular form of lamp, but simply the application of tubes of a non-conducting material, and the protection of such tubes from the effects of the flame of the lamp. The tubes in question may be applied to lamps of every shape and construction, and my claim is intended to cover such application."

The prolongation referred to in the above claim is the extension of the outer metallic tube above the upper end of the non-conducting tubes, for the purpose of protection. The object of substituting non-conducting substances such as wood, china, &c., for the metallic tubes heretofore used, is to prevent the too great evaporation of the oil, and the drying of the wick, which induces the deposite of resinous matter, thereby impairing the capillary action, &c.

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32. For an *Improvement in the Instrument for Cutting Coats, called the "Coat Sector;"* Allen Ward, Baltimore, Maryland, December 26.

The patentee says,—"My coat sector consists mainly of four arms, and of a flexible neck slide, two of the arms lie in a straight line with, and slide upon each other, and might in fact be denominated a sliding arm; but as this sliding arm consists of two pieces, I have denominated them, each piece, as an arm."

Claim.—"Having thus fully described the manner in which I construct my coat sector, and also that in which it is applied to the marking out for cutting a coat, what I claim therein as new, and desire to secure by letters patent, is the manner in which I have arranged and combined the four arms and the neck slide; the respective arms forming the angles herein designated, or nearly such, and the second and third arms being made to slide upon each other, for the purpose of enlarging or diminishing the profile of the garment to be cut; there being also, on three of those arms, divisions, with marks or numbers corresponding with each other in their general proportion and arrangement, as represented in the drawing, and herein fully described. I will here remark that, although the divisions and numbers marked on the respective arms are considered as useful and convenient for despatch, they are not essential, as the measure taken as herein designated may be applied to the arm, and a mark be made upon it the length of the combined arms. B and C may also be determined by the same measure, and the neck slide also be moved thereby to its proper place, these three measures always being about the same.

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33. For an *Improvement in the Method of Raising Spring Water;* Benjamin S. Benton, Harford, Maryland, December 26, ante-dated August 5, 1845.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the raising spring water to a higher level than its source by the momentum of a running stream of river or other water in contact therewith, in a double ram, constructed as aforesaid, or other ram, constructed and combined substantially in the manner set forth, by which analogous results are produced—the two rams being united by an additional pipe, in which the spring and river water come in contact, as above set forth.

"I also claim the combinations and arrangement of the lever, bucket, and valve, with reservoir, as described, for keeping up the action of the machine. I likewise claim the arrangement of the spring for insuring the opening of the valve, as described."

There is a vessel, containing the water to be employed in raising the spring water, that communicates with one ram, and this, by another pipe, communicates with a second ram, which, in turn, communicates, by a pipe, with the reservoir of spring water to be raised. The first ram has a waste pipe and puppet valve, and the second has an air vessel with a valve interposed between the main chamber and the air vessel, and another valve at the end of the pipe that leads from the fresh water reservoir into the chamber of the ram. When the puppet valve of the first ram is opened by a lever, the water from the two reservoirs rushes to and out of the waste pipe, until the momentum is such as to close the valve, and then the propelling water from a greater head than the spring water causes it to return into the second ram, and into the air vessel thereof; at the same time closing the valve in the pipe leading to the fresh water reservoir; this impulse forces the fresh water up through a small pipe leading from the air vessel, to the required height. The return pulsation, &c., takes place as in the common water ram.

For the purpose of keeping the river water at the required height in the reservoir, and to stop the flow when not high enough, there is a spout in the reservoir which discharges water into a bucket on one end of a lever, the other being provided with a valve which closes the pipe that leads to the first ram. The bucket has a small hole in the bottom for the discharge of water, so that when the water in the reservoir is below the required level the water runs out of the bucket, and when empty, the valve end of the lever preponderates, to close the valve and stop the machine, but when the water rises sufficiently to flow over into the bucket faster than it can run out, then the valve is opened, and the operation goes on.

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34. For *Improvements in the Machine for Bolting Flour;* Robert C. Mauck, Honeyville, Virginia, December 26.

Claim.—"Having thus fully described the nature of my improvements in the flouring mill, what I claim therein as new and desire to secure by letters patent, is the manner in which I have arranged the flights around the bolting reel, in combination with the arrangement of the respective spouts HH and I, and with a device for altering the inclination of the bolting chest and reel, for the purpose set forth."

The flights are strips of wood placed diagonally on longitudinal bars on the periphery of the bolting reel, and their object is to force the flour in the inclined trough to a series of discharge spouts (HH,) which lead to an elevator, to be re-transferred to the bolting reel, and these spouts are provided with valves, that any of them may be closed at pleasure, to regulate the quality of the flour which is to be discharged through the upper spout (I.) The lower end of the trough is suspended to a strap, so that it can be raised by a drum.

35. For an *Improvement in Cast Iron Railroad Wheels;* George W. Eddy, Waterford, New York, December 26.

Claim.—"I do not claim the manner of constructing a cast iron or metal railway car wheel, by making it of two convex or concave plates, or one convex and one concave plate, united to a solid or divided hub, and a circular rim and flanch, as heretofore made; but that which I do claim, is my improved manner of constructing a wheel, by which I am enabled to cast it with a solid hub, and in other respects as I have above set forth, viz: by making it with an *undulating* plate, in combination with a concave or convex plate, or another undulating plate, as herein described."

The undulating plate, referred to in the claim, is formed with concentric waves or undulations, which, when the metal shrinks in cooling, will straighten out a little, and thus prevent the metal from breaking.

36. For *Improvements in the Tubular Steam Boiler;* James Montgomery, Memphis, Tennessee, December 26.

Claim.—"Having thus fully described the nature of my improvement in the steam engine boiler, and shown the operation of the same, what I claim as new therein, and desire to secure by letters patent, is arranging the fire chamber or furnace of a tubular boiler at the side, so that the heat shall act on the upper half of the tubes, in combination with a diaphragm or partition and flue to carry off the flame, heated air, &c., to act on the lower half of the tubes, after acting on the upper half, as described.

"And I also claim the making of the bottom of the boiler of a conical or dished form, with a mud or blow-off valve in the lowest part of the concavity, in combination with the vertical tubes communicating with the bottom,' in the manner herein described, to permit the deposite of the sediment, there being a water space surrounding them to induce circulation of the water up the tubes and down the surrounding space, to wash the sediment towards the mud or blow-off valve, as herein described."

37. For *Improvements in the Water Wheel;* John Mecay, Millsborough, Pennsylvania, December 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combining with the spiral scroll the projecting portion of the buckets, marked X in the drawing; and in combination with the foregoing I claim the arrangement of the buckets, substantially as described and set forth."

The case that surrounds the wheel is a scroll that gradually approaches the periphery of the wheel, so as to cause the water to pass into the wheel and to be discharged therefrom around the shaft. The buckets are eccentric from the inner to the outer periphery of the rim of the wheel, and that part which projects beyond the rim, and into the case, and designated in the claim by the letter X, is curved in the reverse direction.

38. For a *Composition Cement for Covering Roofs, &c.;* Wm. Y. Singleton, Springfield, Illinois, December 26.

Claim.—"What I claim as my discovery, and desire to secure by letters patent, is the before described composition of lime, sand and charcoal, forming a cement that is impervious to water; that is to say-I claim to have discovered the use of charcoal and stone coal as a component part of plaster or cement, by which it is rendered impervious to water."

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39. For an *Improvement in Grist Mills;* Josiah Platt, Bridgeport, Connecticut, December 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the suspension of the upper stone by being firmly fastened to a flanch, connected with a hollow spindle through which the mill is fed, said hollow spindle having groovings around its circumference, near each end, fitting the edges of corresponding friction wheels arranged around said spindle, and the arrangement of the segment bar, all in connexion and combination, as aforesaid."

The runner is attached to a hollow spindle, which is suspended, not by journals, but by the peripheries of friction rollers and segment bars—their peripheries being formed to run in corresponding grooves in the spindle.

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40. For an *Improvement in the Mill for Grinding Bark;* Amos Lindsey, Canton, Maine, December 26.

Claim.—"What I claim as my improvement, and for which I ask an exclusive right, is my mode of combining and applying two or more cylinders of circular saws, as above described, viz: by alternating large and small saws, and applying them to each other so that a large and small saw shall be opposite, and cut against each other."

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41. For *Improvements in the Truss;* Lorenzo D. Fleming, Newark, New Jersey, December 31.

Claim.—"What I claim as new in the above described instrument, is the construction of *pockets* in combination with an abdominal *spring pad*, with descending lobes, by which it may be easily adapted to nearly all cases of inguinal hernia, securing a decided advantage over the common truss, by being much easier to the wearer, suiting it to double hernia, and preventing a rupture on the opposite side, which often occurs by wearing the single truss.

"I also claim the employment of *rings* to be slipped into the *pockets* of the *front pad*, for encircling the ruptured spot, in order to contract and excite the muscle, thereby disposing the part to heal. The rings may be made of any shape, diameter, or width, that the form or nature of the rupture may require. The instrument I call '*Dr. Fleming's spring pad supporter and truss.*'"

42. For an *Improved Process for Preserving Potatoes;* Charles S. Edwards, Rushville, Illinois, December 31.

Claim.—"Having thus described the nature of my invention and the best manner I am at present acquainted with for performing the same, I would have it understood that I make no claim to any of the apparatus herein described; nor do I confine myself thereto, although I consider the means above described the most simple and best for performing the invention.

"But what I claim as my invention, is the mode of preserving potatoes in a cooked, or partially cooked state, by means of obtaining the substance of potatoes in a separated or finely divided and dried state, as described."

The process is as follows:—The potatoes, after being washed and boiled until the skins show symptoms of cracking, are skinned and properly stripped of eyes, &c. The potatoes are then formed into fine threads like vermicelli, by being forced through small holes in a cylinder, and then dried on tables exposed to a temperature varying from 100 to 160 Fahrenheit.

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43. For an *Improvement in Cooking Stoves;* Samuel Myres, Schenectady, New York, December 31.

Claim.—"I do not claim the supplying the oven with heated air, by means of a flue in contact with the fire chamber; but I do claim the peculiar construction and particular arrangement of the flue in combination with the chamber and pipes, as I have arranged them in my stove, for conveying heated air through the oven, for the purpose of heating the upper part thereof, as described."

The flue is triangular, and lies in the bottom of the fire chamber, receives air from outside the stove which is heated in passing through, and thence discharged into a chamber between the fire chamber and oven, and from this chamber the heated air passes through vertical pipes placed in the horizontal flue, to the upper part of the large oven, and when mixed with the gases generated in the oven, passes off together through a pipe into the main flue of the stove.

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44. For an *Improvement in Reed Musical Instruments;* Nathan B. Jewett, Worcester, Massachusetts, December 31.

Claim.—"I therefore claim the disk upon the extremity of the lip of the reed, in combination with a corresponding enlargement of the air passage of the reed plate as described.

"Also, bending the stem of the reed at an angle with the lip, and also so bending the same, and in the form of an inverted U; the whole being substantially as above explained."

This is intended for the purpose of improving the tone of the reed and tuning it with more facility. The back part of the reed is attached to the sound board above its surface, so as to have the tuning slide above and below. The reed is then turned up like an inverted U, and then runs horizontally with an enlargement at the end, which alone receives the action of the current of air.

45. For an *Improvement in the Bee Hive;* James Robb, Lewistown, Pennsylvania, December 31.

This claim refers to and is wholly dependent on the drawings, and we are therefore under the necessity of omitting it. It is limited to the peculiar manner of constructing and arranging a sliding and, a vibrating trap for crushing the moth when attracted by the warmth under these traps.

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46. For an *Improvement in the Pulp Strainer for the Manufacture of Paper;* Wm. Bishop, Coventry, Connecticut, December 31.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of clearing pulp, to be used in the manufacture of paper, from sand, gravel, metallic and other hard and injurious substances, by means of the above described pulp-sand strainer."

This strainer consists of a box with a series of round bars placed near together and on the same plane, so that the pulp in flowing over the bars will flow in undulations which tend to deposite the impurities between the bars and in the box below.

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47. For an *Improved mode of Ascending Inclined Planes on Rail Roads;* Ezra Coleman, Philadelphia, Pennsylvania, December 31.

The locomotive is provided with an endless screw with its axis parallel with the rails, which can be connected with the driving or crank axle, for the purpose of drawing the load up inclined planes by having the threads of the screw take into cogs, made of friction rollers, on a rack placed between the two rails, the driving axle being provided with loose running wheels alongside of the drivers, for the purpose of raising the drivers from the rails when the screw acts on the cogs.

Claim.—"Having thus fully described the nature and operation of my invention, what I claim as new therein, and desire to secure by letters patent, is the placing an independent set of bearing wheels within the frame of the locomotive, revolving loosely upon the main driving shaft, and adapted to an inner extra track of rails, (raised above the main track,) for the purpose of sustaining the weight of the locomotive in ascending or descending inclined planes, lifting the driving wheels from the main track of the rails, and rendering the action of the driving shaft independent of the bearing or driving wheels, when it is desired to transfer the whole power of the locomotive steam engines from the driving wheels to the endless screw, geared to the driving shaft, and its thread working into a rack of friction rollers; the whole arranged, combined, and operating substantially in the manner and for the purpose herein set forth."

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48. For an *Improvement in the Bee Hive;* Aaron Colton, Pittsfield, Vermont, December 31.

Claim.—"Having thus fully described the construction and operation of my improved bee-hive, what I claim as new therein, and desire to secure by letters patent, is the manner in which the honey or lateral boxes are arranged, in combination with a pyramidal central hive, constructed and operating substantially in the manner and for the purpose set forth."

The honey boxes are placed one above the other on each side, but gradually approaching the middle of the hive, that is to say, the second range of boxes are so much nearer the centre as to have a portion of their bottom project sufficiently into the hive as to leave an entrance at the bottom for the bees, and so of the other ranges.

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49. For an *Improvement in the Refrigerator;* Joseph T. Craddock, Baltimore, Maryland, December 31.

The nature of this improvement consists in so combining a filter for filtering the water, with a refrigerator that the water when drawn off from the refrigerator shall be supplied from the filter and consume no more ice than is required to cool the quantity of water required for use

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the filter, arranged substantially as described, in combination with the cooling chamber surrounding the ice chamber, located and arranged substantially in the manner and for the purpose specified."

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50. For an *Improvement in the method of Mounting the Booms of Vessels;* James Davis, Jr., Gloucester, Massachusetts. December 31.

Claim.—"The main feature in my said new and improved boom saddle and jaws, which I claim as my invention, and desire to secure by letters patent, is the following, reference being had to the description and drawings, viz: The method of constructing a saddle so as to leave a space between the mast and the saddle, in connexion or combination with the insertion of the slide or slides in the jaws of the boom."

The jaws of the boom are cut out towards the mast to receive slide pieces, which will turn when either end of the boom moves without the other, so that their bearing surface against the mast will always lie fair to avoid bighting.

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51. For *Improvements in the Manufacture of Nails, Pins, Screw blanks, Rivets, &c.;* Samuel G. Reynolds, Bristol, Rhode Island, December 31.

Claim.—"Having now described the construction of the improved machinery to be employed in the manufacture of nails, rivets, screws, and pins, I desire to be understood that I claim, in reference to the heading of metal rods or wire for the above purposes, the means of effecting what I call a "double upset," viz: by crushing the end of the rod or wire for forming the boss or head of the nail, rivet, screw or pin, by two or more operations of a single heading-punch and pair or set of holding dies and the sliding guides, the whole in combination as described; the rod or wire being brought forward between the holding dies a short distance by the sliding guides, after the first or partial crushing of the metal has been effected, in order to supply a sufficient additional quantity of metal to complete and perfect the form of the boss or head when the second pressure of the punch is brought up against it. As respects the pointing of pins, and discharging them from the machine, I claim my improvement therein; the same consisting in imparting to the sliding-bar certain alternating, lateral, and back movements in its bearings, as described, whereby the pins are turned in opposite directions during the action of the mill-roller upon them, and discharged from the machine when the pointing of them has been completed."

52. For an *Improved Apparatus for applying Medicated Baths;* Benjamin Sweet, Mount Morris, New York, December 31.

Claim.—"What I claim as my invention is the mode, herein described, of applying medicated vapors; that is, by submitting the body or parts thereof to the vapor of the substance used, without the presence of steam, by means substantially the same as herein set forth."

The vapor is generated in the outer casing of a double cased stove, the outer space of which communicates with a box in which the patient sits with his head out, the top of the case being fitted to his neck.

List of American Patents which issued in the month of April, 1842, *with Exemplifications, by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

(Continued from vol. xii, page 154.)

26. For *Improvements in the Plough;* George Watts, Gainesville, Alabama, April 11.

The beam instead of being connected with the standard by tenon and mortise, is attached to the side of the standard by a staple, (called a "cuff" in the specification,) which embraces the beam and passes through the standard, and is then secured by nuts. The coulter is in like manner secured to the beam, to avoid weakening the beam by perforations.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the mode of fastening the beam to the side of the standard by means of the cuff embracing the beam and passing through the standard, by which arrangement the beam is not weakened by perforations for the usual bolt fastenings or tenonings, and likewise the beam is rendered adjustable, in the manner and for the purpose above described.

"I also claim the method of attaching and bracing the coulter to the beam, by means of cuffs embracing the beam, in the manner described, instead of being bolted through the beam, as heretofore."

27. For *Improvements in Machinery for Cutting Shoe Soles;* Elias T. Ingalls, Haverhill, Massachusetts, April 11.

The knives that cut the two sides of the sole, (leaving the heel and toe to be trimmed,) are each attached to a separate block, and the two blocks are connected together with screws, to admit of adjusting the cutters on the die to different sizes. This constitutes the subject of the first claim; but the second claim we are under the necessity of omitting, as it is wholly dependent on the drawings. It is limited to the combination of parts by which the position of the leather is regulated for each cut.

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28. For *Improvements in Heating Buildings;* Reuben Mitchell, Portland, Maine, April 11.

In this furnace and fire-place there are two fire-chambers, for the objects and in the manner pointed out in the following

Claim.—"Having thus described my improvements, I shall claim arranging a hot-air chamber, beneath the hearth of the fire-place, or between said hearth and the ash chamber under the same, and in combination therewith depressing the fire-pot or furnace below the level of the hearth or into the hot-air chamber, the same being constructed substantially as hereinbefore described, and for the purpose before mentioned.

"Also, constructing the upper fire-place with sliding doors, by which it may be closed, and forming an opening in its rear, and a damper in the main flue, above said opening; by which arrangement, the smoke and other heated products of combustion may be caused to circulate through the fire-place (and flues of the same,) of the room, and to impart heat, substantially as described. Also, separating the lower fire-place from the hot-air chamber below it, for the purpose described, by means of a plate or slab, as set forth."

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29. For an improved *Compound for Promoting the Growth of Hair;* Vair Clirehugh, New York, April 11.

Claim.—"What I claim as new and desire to secure by letters patent, is the combining together of alcohol, of the active principle of cantharides, and of iodine, substantially in the manner and for the purpose set forth. I also claim the further combination of muriate of ammonia and of castor oil, or either of them, with the first named compound of alcohol, cantharides, and iodine; the respective ingredients being employed in the proportions designated and made known."

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30. For an *Improvement in the Process of Tanning Leather;* Joseph Southwick, Boston, Massachusetts, April 11.

Instead of the usual process of handling hides, this patent is granted for placing them in a trough, in which they are to undergo the operation of pounding, or filling in the tanning liquor.

Claim.—"Having thus described my improvements in the process of tanning by machinery, suspending the necessity of 'handling' the hides or skins, (for the purpose of producing uniformity of color,) and impregnating or infusing into the same the tannin, or essence of the astringent solution, by subjecting them to the action of the vibrating beaters in the tannin trough, or the fulling process above described, the whole arrangement and operation being substantially as above set forth."

31. For *Improvements in Machinery for applying Paste or Sizing to the Surface of Sheets of Paper, for making Cards or Pasteboards;* David H. Gilbert, Dorchester, Massachusetts, April 11.

Claim.—"Having thus described my improved machinery, I shall claim applying paste or adhesive matters to sheets of paper or other material, by drawing said sheets by a sliding carriage frame between two cylindrical or suitable brushes, revolving or moving in contiguity with each other, all substantially as above set forth; also, the combination of said carriage frame with the table, and also with the movable apron for the purpose of depositing the pasted sheets of paper in a regular pile upon said table, the said combined machinery being constructed and operated substantially as described.

"I further claim the machinery for freeing or separating the sheet of paper from the finger-bar and carriage, so that said sheet may fall upon the table; the said machinery consisting of the plate with its rods extending rearward therefrom, the weighted shaft with its projecting arms, and the stud of the table; the same being arranged, combined together, and operating substantially as herein described."

32. For an *Improvement in Window Shutters, called the "Window Guard;"* Arthur L. Johnson, Baltimore, Maryland, April 11.

Claim.—"I do not claim to have invented a 'window guard,' or shutter, consisting of slats joined together, as this has long since been done; but what I do claim as my invention and desire to secure by letters patent, is the making the ends of the slats in the various forms herein described, to fit into grooves in the frame, substantially as herein described, whereby to prevent the slats from being drawn out should they be separated from each other by violence, and also for the purpose of preventing the paint from being chafed off of the guard, in the operation of rolling up, as herein described."

33. For an *Improvement in the Cotton Press;* P. G. Gardiner, New York, April 16.

Claim.—"It is to be understood that I do not claim the attaching of a curved rack or toothed segment to one of the arms of that kind of progressive lever usually denominated the toggle joint, and the combining therewith a toothed pinion, by means of which, said levers shall be actuated; but what I do claim as new, and desire to secure by letters patent, is the particular manner in which I have arranged and combined the toothed segment, the pinion, and the toggle joint, as above set forth, the curved segment being attached to, and extending from end to end of the upper arm of the progressive levers, and having the requisite eccentricity to enable the pinion to operate upon it, under an arrangement of parts substantially the same with that herein fully described; and I also claim, as a modification of said arrangement, the substitution of chains or bands for the toothed gearing, such chains or bands passing over a plain segment, and being operated upon by a shaft, around which they wind, this latter answering the purpose of the toothed pinion, the principle of action being the same in either case."

34. For an *Improvement in the Air-heating Stove for Warming Buildings;* Salvin F. Kellogg, Norwalk, Ohio, April 16.

Claim.—"Having thus fully described the construction of my air-heating stove, and shown the manner in which the same operates, I do hereby declare that I do not claim the conducting of cold air into an air-heater, nor the subsequent conveying of the air so heated to distant apartments, this having been previously effected, and by means of apparatus constructed in a variety of ways; but I limit my claim to the particular manner herein described, in which I have combined and arranged the stove, the air-heating chambers or flues, and the boilers with their appendages, as above set forth; that is to say, I claim the manner of forming the air-heating chamber or flue, and of arranging it within the stove, so as to occupy the whole width thereof, and to have its upper and lower plates, and its sides, exposed to the direct action of the fire, or to that of the heated air immediately escaping therefrom. I also claim the manner of combining the boilers, the heated air pipe, and the smoke pipe, by tubes leading into each, the respective parts being governed by valves, in the manner and for the purpose above set forth."

35. For an *Improvement in Ploughs;* Thomas Wiard, Avon, New York, April 11.

This patent is granted for an arrangement of parts for uniting the share, mould-board, and land-side, by certain overlapping joints. We omit the claim, as it could not be understood without drawings.

36. For *Improvements in Furnaces and in the manner of applying Heat to the Manufacture of Iron, &c.;* C. E. Detmold, of New York, assignee of W. Von Faber du Four, of Wirtemburg, April 16, 1842; granted for 14 years from the 12th of November, 1841.

This patent was re-issued for amendments of the specification on the 23rd of January, 1845, and noticed at page 250, vol. x, 3rd series of this journal, to which the reader is referred.

37. For an *Improvement in the Churn, for Churning, Working, and Salting Butter;* Lemuel Adams, Redding, Connecticut, April 16.

In the centre of a tube there is a vertical shaft with two horizontal arms, near the end of each of which there is a pendant stud pin, on which rotates a beater, and these beaters have their peripheries grooved, and by the turning of the shaft, the beaters roll around the inner periphery of the tub, and either churn or work the butter.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the use of the horizontal rotary beaters, for churning, working, and salting butter, as herein described."

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38. For an *Improvement in the Brick Press*; A. K. Fahnestock, Harrisburg, Pennsylvania, April 16.

The patentee says: "The nature of my invention consists in attaching to the upper end of the upper lever in the press a slide box and joint, to work on a stem connected with the bottom piece of the mould, in connexion with the present arrangement of the levers and two braces for the slide box to rest on, by means of which, the cap piece of the press is relieved by the forward stroke of the hand lever, after making the pressure."

Claim.—"What I claim as my invention and improvement, and desire to secure by letters patent, is attaching to the upper end of the upper lever, in the above described press, a slide box and joint, to work on a stem connected with the bottom piece of the mould, in connexion with the present arrangement of the levers and two braces, for the slide box to rest on, by means of which, the cap of the press is relieved by the forward stroke of the hand lever after making the pressure."

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39. For an *Improved Instrument for Plotting Surveys;* Wm. J. Card, Lancaster, Pennsylvania, April 16.

Claim.—"What I claim as my invention and desire to secure by letters patent, under the name of the Theolodian protractor, is the application of a graduated circle and nonius or vernier to a movable triangle or right angle, combining, for that purpose, as above described, four pieces of wood or metal, namely, a semi-circle, a sector, a nonius, and diagonal scale of equal parts, which latter also forms a parallel ruler."

Proceedings of a National Convention of Inventors of the United States, held in the City of Philadelphia, October 27th, 1846.

A Convention of Inventors, and others interested in patents, of the United States, convened in the hall of the Franklin Institute, in the city of Philadelphia, October 27, 1846, pursuant to a call of the Executive Committee, appointed by a Convention of Inventors, &c., of the United States, held in the city of New York, October 22, 1845.

Col. Clark, of New York, was called to the chair; and on motion of Charles M. Keller, Esq., of Washington, a committee of three was appointed by the chair to nominate officers for this Convention.

The chair appointed Messrs. Asa Whitney, Capt. Loper, and J. H. Towne, of Philadelphia.

The committee reported the following officers, who were unanimously elected by the Convention:

President,	Isaiah Lukens, Esq., of Philadelphia.
Vice Presidents,	Col. E. Clark, of Brooklyn, N. Y. John Wiegand, Esq., of Philadelphia, E. B. Bigelow, Esq., of Boston.
Secretaries,	George Gifford, Esq., of New York, James Herron, Esq., of Philadelphia.

The proceedings of the Convention held in the city of New York, Oct. 22d, 1845, together with the call of the Executive Committee, being read, the committee, through their chairman, Charles M. Keller, Esq., presented the following report, together with their memorial to Congress, and a copy of the bill reported by the respective committees of both houses of Congress, at the last session.

Report of Executive Committee.

The committee appointed by the Convention of Inventors which met in the city of New York, on the 22nd of October, 1845, have called the present Convention in conformity with the instructions received from the first Convention, for the purpose of reporting the result of their labors. Under their instructions, the committee met in consultation, prepared a memorial as directed, in which they endeavored to present to the Congress of the United States the views of the Convention, to point out the defects in the existing laws of patents, and the beneficial effects anticipated from the proposed change. They then submitted to the committees of the two houses of Congress, and to the Commissioner of Patents, the project of a law amendatory of the existing law. On this project, the Commissioner of Patents prepared a bill, which was approved by the committees in Congress, and by them reported unanimously to the two houses of Congress, and printed; but in consequence of the press of great political questions, and the late period of the session at which the bill was reported, the committees were unable to procure a two-thirds vote, which was necessary to take up the bill out of its regular order on the docket. The committee therefore submit to the present Convention their memorial and the bill reported to Congress.

The committee urged upon Congress all the views of the Convention from which they derived their power; but one of the most important resolves of the Convention, the one which relates to the appointment of special judges, although urged with zeal, was not adopted by the committees of Congress, not because they disapproved the proposition, but for fear that it would lead to much opposition in Congress, and to the defeat of the bill; but recommended to the committee of the Convention the propriety of urging this provision in a separate bill.

All which is respectfully submitted,

Chas. M. Keller,
Horatio Allen,
Solomon Andrews,
Jordan L. Mott,
James Bogardus,
Executive Committee.

The reading being concluded, on motion of Mr. Gifford, of New York, it was unanimously resolved, that the report of the committee be received.

Clinton Roosevelt, Esq., of New York, presented and read a preample and substitute for the whole bill. His motion was seconded, by a Philadelphian, to allow of the reading.

A long discussion ensued on a motion to refer the Congressional bill and substitute of Mr. Roosevelt to a select committee, in which Messrs. J. Curtis, of New York, C. Roosevelt, William Leighton, of Portsmouth, N. H., H. R. Campbell, of Philadelphia, Jas. G. Wilson, of New York, and Mr. Serrell, of New York, participated; and the question being taken, the motion was not agreed to, and it was finally referred to the Executive Committee.

A resolution was then offered by H. R. Campbell of Philadelphia, to add to the number of the Executive Committee, for a like purpose, which led to a very animated debate by Messrs. Serrell, J. Alricks, of Wilmington, Horatio Allen, of New York, E. B. Foster, of Philadelphia, and C. M. Keller, of Washington; during which there were several amendments proposed, and voted down, as was the resolution itself.

Finally, the Convention determined to take up the bill as reported by the committees of Congress, and pass upon it, section by section.

Action of the Convention on the Bill.

Section 1.—Being under consideration, it was amended by changing the amount of salaries in the bill: for chief examiners from $2500 a year to $3000; and the salaries of assistant examiners from $2000 to $2500.

Sec. 2.—Carried, without amendment, as in the bill.

Sec. 3.—Passed over, by consent, without action.

Sec. 4.—Carried, with the exception of the proviso.

An amendment was offered by Mr. Gifford for the proviso. Pending which, it was resolved, on motion of Mr. Curtis, that when this Convention adjourns, it shall be to meet again at half past four o'clock.

On motion of Mr. H. R. Campbell, the Convention then adjourned.

Afternoon Session.

The Convention met at half past four o'clock, P. M., pursuant to adjournment; and the proviso to section 4, as amended in Congress, being under consideration, Mr. Gifford called up his substitute, which, on motion of Mr. Allen, was referred to the Executive Committee, to be incorporated in the bill, in case provision was not made elsewhere for the object. Agreed to.

Sec. 5.—Mr. Roosevelt moved to strike out the caveat fee of $10, which motion was rejected, and the section adopted as it stood.

Sec. 6.—Was struck out of the bill.

Sec. 7.—Stands in place of 6, and was adopted as in the bill.

Sec. 8.—Mr. H. R. Campbell moved to strike out after line 18, which was not agreed to. Also, after line 28, which motion was not agreed to. The section was then carried unanimously.

Sec. 9.—Was, on motion of Mr. Gifford, amended, and carried unanimously.

Sec. 10.—Concurred in.

Sec. 11.— Do. do.

Sec. 12.—Amended so as to require that the declaration of abandonment be made in the presence of at least three witnesses, and adopted as amended.

Sec. 13.—Agreed to.

Sec. 14.—Carried, with but one dissenting voice.

Sec. 15.—Concurred in, subject to the revision of the Executive Committee.

Sec. 16.—Carried.

Sec. 17.—Amended, by striking out $3 and inserting $2·50 for recording. And striking out 10 cents a volume for examining.

On motion of Mr. Serrell, section 16 was called up for re-consideration, and amended, by a proviso, that the drawings and description shall not be published for six months after the patent has been issued.

Sec. 18.—Agreed to.

Sec. 19.—Struck out of the bill.

Sec. 20.—On motion was amended, by charging cost to the patent fund.

On motion of Mr. Curtis, it was resolved, that the thanks of this Convention be presented to the Executive Committee for the very able and efficient manner they had attended to the duties entrusted to them, and that they be requested to continue the same during the ensuing year.

A vote of thanks was passed to the board of managers of the Franklin Institute, for the use of their hall, in which the Convention sat.

Also, to Col. Clark, for the courteous and dignified manner in which he presided over the Convention.

The Convention then adjourned, to meet again at such time and place, as may be designated in a call of the Executive Committee.

EDWARD CLARK, President.

GEORGE GIFFORD, } Secretaries.
JAMES HERRON, }

SPECIFICATIONS OF ENGLISH PATENTS.

Specification of a Patent granted to James Garforth, *of Dukinfield, in the county of Chester, for improvements in machinery or apparatus for connecting metallic plates, for the construction of boilers and other purposes.*—[Sealed 10th December, 1845.]

These improvements in machinery or apparatus for connecting metallic plates for the construction of boilers, consist in the direct application of the expansive force of steam to the dies for riveting such plates together, and in an arrangement of machinery whereby such force is brought into action.

In plate I., fig. 1, represents a plan or horizontal view of an arrangement of machinery or apparatus designed for connecting or riveting metallic plates for the construction of steam-boilers; fig. 2, is a side view; and fig. 3, a section, taken longitudinally through about the centre of the apparatus. *a, a,* is the frame-work for supporting the steam-cylinder *b, b,* in which a steam-tight metallic or other piston *c, c,* works; this piston *c, c,* is mounted upon the rod *d, d**, which passes out through stuffing-boxes *e, e,* at each end of the cylinder *b, b*; in the end *d** of the piston-rod the die *f*, is fixed, the other die *g*, being mounted in the pillar *h,* which is fast to the frame-work. Steam being admitted through the entrance or feed-pipe *i,* it passes onwards through a common slide or other valve *k,* to the cylinder; and after having performed its office, is allowed to pass out through the pipe *l.* The side-valve *k,* is worked by hand, by means of the lever *m,* so as to admit the steam on either side of the piston, as required.

The operation of the apparatus is as follows:—Steam of a sufficient pressure being admitted (by means of the slide-valve *k*,) at the back, or as it appears in fig. 3, of the drawing, at the left-hand side of the piston *c, c,* that piston will be forced, together with the piston-rod *d, d**, in the direction of the arrow, and form the ends of the rivet *n*, between the two dies *f*, and *g*; thus firmly connecting the plates *o*, and *p*, and thereby producing a perfectly steam, air, or water-tight joint.

The head of the rivet is formed at one or more blows, as required; the intensity of the blow depending upon the area of the piston, the length of the stroke, and the pressure of the steam employed. The valve *k,* is then reversed, to admit the steam in front of the cylinder; which movement will withdraw the die *f*, when another rivet may be put in, and the operation proceeds as before.

The patentee remarks, that he does not intend to confine himself to the use of steam alone for such purposes, as the direct pressure of water, air, or other elastic medium may be similarly employed, without departing from the principle of his invention. He states, that he does not claim the exclusive use of the several parts of the above-mentioned apparatus, when taken separately, but only when employed for the purpose of his invention, which consists in the riveting of metallic plates by dies, driven by the elastic force of steam, water, or other elastic medium, as above described.—[*Inrolled June*, 1846.]

Lon. Jour. Arts & Sci.

Specification of a Patent granted to WILLIAM HENRY WALLER, *of Lambeth, in the county of Surrey, for improvements in sluice-cocks.*—[Sealed 31st October, 1845.]

The patentee commences his specification by pointing out the defects of the sluice-cocks now generally employed, which are liable to leak, and quickly become injured by use. His invention consists in applying movable bushes or facings to sluice-cocks, and in constructing the bushes in such a manner that they shall be harder, and fit more truly, and may be more readily applied, and replaced when worn; it further consists in a mode of rendering the working surfaces of sluice-cocks, which are made without movable bushes, more hard and durable.

In Plate I., fig. 4, is a vertical section of the improved sluice-cock; fig. 5, also represents a vertical section, taken on the line A, B, of fig. 4; and fig. 5*, is a horizontal section, taken on the line C, D, of figs. 4 and 5. *a*, is the body of the cock; and *b*, *b*, are portions of two pipes, which enter the sockets of the cock, and are retained therein water-tight by the application of melted lead, in the usual manner. The body of the cock is bored out at the points 1, 2, 3, and the backs of the bushes *c*, *c*, are turned in a lathe, so as to fit the recesses thus formed. The bushes are made, by preference, of cast-iron (although other metal may be used;) the working surfaces 4, 4, are chilled in the act of casting, and are ground or "faced up" with emery in a lathe. The bushes are coated on their backs with marine glue, or similar material, previous to introducing them into the cock; and after the bushes have been introduced into the cock, they are moved back in the recesses before mentioned, into a proper working position, by forcing down the plug *d*, into its place. The patentee does not confine himself to the shape of the recesses formed in the body of the cock, as that may be varied. *e*, is a screw for raising and lowering the plug; *f*, is a screw-nut, fitted into a recess at the top of the plug; *g*, *g*, are ribs, formed on the interior of the upper part of the cock; and *h*, *h*, are corresponding ribs on the outer surface of the upper part of the plug; the use of the ribs being to guide the plug correctly in its movement up and down. The surfaces 5, 5, of the plug are chilled in the act of casting, and are then ground with emery.

When making sluice cocks without movable bushes, the patentee causes the surface against which the plug works to be chilled in the act of casting the body of the cock, so as to make it more durable; and this surface is afterwards rendered true by means of a revolving tool and emery.

The patentee claims, Firstly, the mode of preparing the bodies of sluice-cocks with recesses for receiving bushes; the planes of the surfaces 1, 2, 3, being inclined to the central line of the barrel

of the cock, as above described. Secondly,—the mode of applying movable bushes to cocks. Thirdly,—making the movable bushes, and also the plugs of sluice-cocks, with chilled working surfaces, as described. Fourthly,—the making of sluice-cocks with chilled surfaces, which form the bed of the plug.—[*Inrolled April,* 1846.]
Ibid.

Specification of a Patent granted to JOSEPH COWEN, *of Blaydon Burn, near Newcastle-upon-Tyne, for his invention of certain improvements in making retorts for generating gas for illumination.*—[Sealed 4th June, 1844.]

These improvements in making retorts for generating gas may be considered under two heads; firstly, the new combination of earthy and other materials, of which the retorts are to be constructed; and, secondly, the novel kind of moulds and machinery by which the retorts are to be shaped and manufactured.

The object of the patentee is to make such clay retorts for generating gas, as will be capable of withstanding the effects of the various changes of temperature to which they are required to be exposed, and consequently render them less liable to crack. To accomplish this, he proposes to mix with Newcastle fire-clay, Stourbridge fire clay, or any other kind of clay suitable for the purpose, saw-dust, pulverized wood, charcoal, coke, carbon obtained from the interior of gas retorts, and other carbonaceous materials, in such proportions as the quality of the clay may require. The more aluminous the quality of the clay, the larger will be the quantity of carbonaceous matter required to be combined therewith. From one-twentieth to about one-fourth, by measure, of carbonaceous matter, compared to the whole mass of earthy materials employed, may be combined; this variation of quantity depending, as before stated, upon the aluminous condition of the clay,—a feature well understood by potters and the makers of clay retorts. By these means the clay is rendered partially porous, and consequently less liable to crack by the changes of temperature. Clay retorts for the generation of illuminating gas, of all forms and structures, may be made of these combinations of earthy and carbonaceous materials.

The second part of this invention applies to the peculiar kinds of moulds, and the machinery to be employed, for manufacturing gas retorts from earthy materials, which will be seen by reference to Plate I.

Fig. 6, represents the external appearance, as seen from above, of the improved machine for forming retorts of clay by compression; fig. 7, is an end view of the same; and fig. 8, shows the internal parts of the machine, by means of a longitudinal section, taken vertically. *a, a,* is a cylindrical box or chamber, into which the plastic clay and other materials are to be introduced, through a man-hole or aperture *b,* at the top; *c, d,* is a core, made towards the end *c,* to the figure of the required internal form of the retort, the other part of the core *d,* being cylindrical and hollow, for the sake of lightness. This core is placed concentrically within the cylindrical box or chamber *a*, and is made fast thereon by a stud and key *e*, to the end plate *f*, *f*, of the cylinder. A circular plate *g*, acts as a piston within the cylinder, sliding over the core *d*, for the purpose of compressing the plastic clay and other earthy materials contained therein; which piston has several rods *h*, *h*, *h*, affixed to it, whereby any actuating power or mechanical force may be applied to drive the piston forward. To the front end of the cylinder there is attached a nose-piece *i*, *i*, with a plate *k*, which, together, may be called the mould; for, on the piston being forced up, the plastic clay is made to fill up the nose-piece, and to mould or form the end of the intended retort; which, when the machine is in operation, will be known by small portions of the clay oozing through the hole or holes in the front plate *k*. It will be seen by the drawing, that the retort about to be made by this machine is nearly of the transverse sectional figure of the letter D; but to this figure the inventor does not confine himself, as any other form of retort may be made, by means of the same machinery, by altering the shape of the nose-piece *i*, *i*, and the end part of the core *c*, both of which are made movable for that purpose.

The end of the intended clay retort being thus formed in the nose part of the machine, the plate *k*, must be removed from the nose; when, on forcing the piston, *g*, forward, the plastic clay will be projected out at the end of the nose in the shape and as a continuation of the retort (the end of which had been formed as described), to any length required, in the manner shown by the sectional fig. 8, where it may be received and supported by an endless traveling cloth, or a board and rollers; and the length of moulded clay may then be cut off by a wire in the ordinary way, and sent to the drying place.

Another form or modification of this machine is shown in longitudinal section at fig. 9, in which, instead of the nose-piece above described, a D-formed hoop *l*, *l*, or of any other required figure, is introduced as a die; which, in commencing the operation of making the end of the clay retort, must be kept in its place, and the front of the cylindrical box closed by a plate *k*, as before. The core *c*, formed to the desired internal figure of the retort, is in this instance made fast to the piston *g*, and advances with it. When the end of the retort has been made as before described, the plate *k*, must be removed, and on now projecting the clay forward, it will assume the moulded form shown in the front view, fig. 10, and in the section, fig. 11, in which the plate *k*, is removed. Under some circumstances the patentee proposes to use (instead of the machinery above described) peculiarly constructed hand moulds, shown at figs. 12, and 13, for the formation of clay retorts. These moulds may be made either of wood, metal, or plaster, in two or more parts, according to the size and figure required. Fig. 12, shows a top view of one of the moulds of a D form, which is the shape most commonly used. The mould is curved at *a*, *a*, the part which is to constitute the roof or top; the bottom *b*, is a flat plate, capable of being detached, which is best suited to this form, and to ordinary-sized retorts. The two, or it may be more, parts of the mould, when combined, are to be made fast by external bracings of iron hoop *c*, *c*, with a bar *d*, keyed or screwed thereto; or, if the mould is made of plaster, rope bracings will suffice.

In commencing the operation of moulding a clay retort by means of this apparatus, the interior of a single mould is uniformly worked over, by hand, with a substantial coating of the clay; the clay is then beaten down to any required uniform thickness, which may be from about two to four inches. When this first mould has been thus coated, and so much of the clay retort shaped and finished, a similar mould is to be placed upon the top of the former, their edges perfectly coinciding, and they are then to be bolted together. This being done, the interior of the second mould is coated with clay, in like manner to the first; taking care that the plastic clay of the second operation shall be perfectly united with the edges of that produced in the former mould. In this manner the retort may be continued to any length, by erecting one mould upon another, and carefully joining them, as shown at fig. 13. In some cases it will be found desirable to line the internal parts of the moulds with flannel or cloth, to prevent adhesion. It may be necessary for the moulds to remain upon the moulded retort for some hours, in order that the clay may become perfectly stiff before they are removed; but of this no precise instructions can be given, as it will vary, and must depend upon the consistency or stiffness of the materials used.

The patentee claims, Firstly,—the introduction, or mixing, of carbonaceous matters with the clay, previously to its being moulded into retorts for generating illuminating gas; Secondly,—the novel kinds of moulds and machinery for forming retorts of clay and other earthy materials, intended for the generating of gas, as above described.—[*Inrolled December*, 1844.]

Ibid.

Specification of a Patent granted to Thomas Lever Rushton, *of the county of Lancaster, for certain improvements in the manufacture of iron.*—[Sealed 21st June, 1844.]

This invention relates to the manufacture of malleable iron in reverberatory furnaces.

The first improvement consists in mixing hammer slack, roll scale, red ore, calcined iron stone, or other oxide, in a pulverized state, with a proportion of finely pulverized charcoal, coke, or other suitable carbonaceous matter (which should be as free as possible from sulphur,) and introducing the mixture into the furnace before, or along with, or immediately after, the charge of pig or refined iron. The mixture of ore and carbonaceous matter is turned over from time to time, until the iron is melted, and then they are worked together in the usual way. The patentee says, that this process is very similar to that described in the specification of a patent, which was granted to W. N. Clay, March 31, 1840; but, in the present instance, the proportion of carbonaceous matters varies from 17 up to (but not including) 28 per cent. by weight of the ore or oxide; whilst Clay's invention

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Plate I. Vol. XIII. 3rd Series

Fig 2.

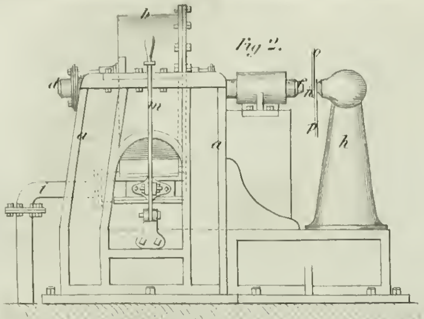


Fig. 3

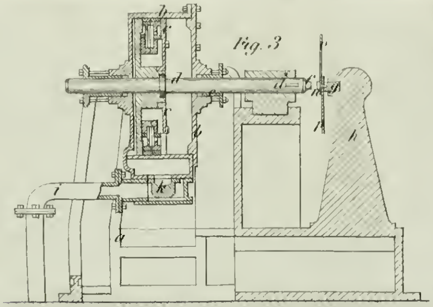


Fig 6

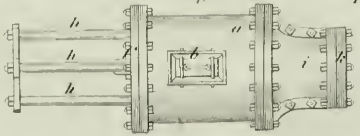


Fig 7

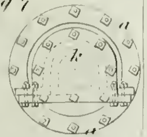


Fig. 8.

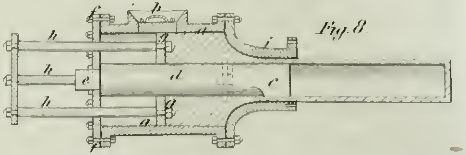


Fig 1

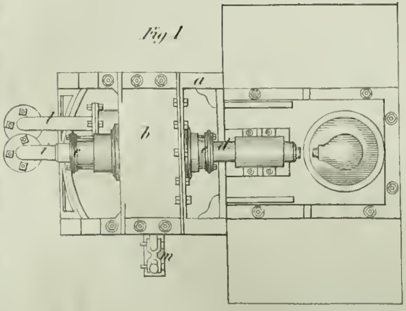


Fig 4.

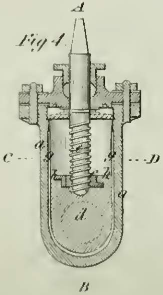


Fig 5

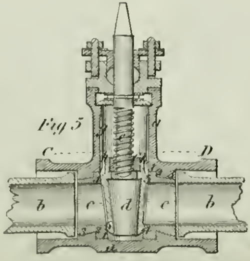


Fig. 5'

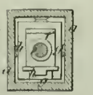


Fig 12.

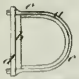


Fig. 9

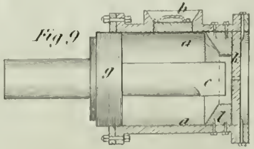


Fig 10

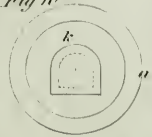


Fig 13

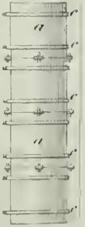
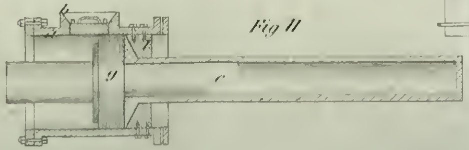


Fig 11



was confined to the use of not less than 28 per cent. The proportionate weights of carbonaceous matter and ore or oxide employed, within the above limits, depend upon the quantity of carbon and oxygen they respectively contain, the description of pig-iron used with them, and the amount of pig-iron to be added to the mixture. The following proportions produce an abundant yield of excellent iron:—480 lbs. of No. 4 pig-iron, 84 lbs. of Lancashire hematite ore, and 20 lbs. of coke-dust: if No. 1 pig-iron be used, a smaller quantity of carbonaceous matter will be required; but if the charge of No. 4 pig-iron be reduced to 420 lbs., the weight of ore or oxide should be increased to 180 lbs., and the coke to 48 lbs.

The second improvement consists in the addition of clay, argillaceous ironstone, or other substance containing alumina, to the ores or oxides which produce iron of the quality termed red-short. The clay, or other substance used, should be ground fine and dried, before being mixed with the ore. A larger quantity of carbonaceous matter (generally above 28 per cent.) will be required for a given quantity of ore, than if no clay were used; for the clay, in addition to its capability of taking up the carbon, has a tendency to diminish the contact of the ore or oxide with the carbonaceous matter, and thereby prevent a complete decomposition. The proportion of clay will vary with the quality of the ore, but from 4 to 10 per cent. of the weight of the ore will be sufficient when operating on the Lancashire hematite ores. If too much clay be used, the tap cinder will be very sluggish, and the ball, when under the hammer, will emit continuous showers of dark red cinders; and if too little be employed, the iron will retain some of its red-short quality.

The third improvement consists in combining a portion of the tap or flue cinder of puddling and balling furnaces with a portion of clay, chalk, carbonaceous matter, and rich iron ore, or some of these substances, and manufacturing the mixture (either with or without pig or refined iron,) in reverberatory furnaces, into malleable iron. The materials must be pulverized and dried before being mixed together. The relative proportions of the different substances may be as follows:—150 lbs. of tap cinder, containing about 71 per cent. of protoxide of iron, 150 lbs. of Lancashire hematite ore, 20 lbs. of pulverized Worsley fire-clay, 20 lbs. of chalk, and 100 lbs. of coke-dust.

With regard to the first part of this invention, the patentee says he does not claim to have discovered the manufacture of malleable iron in reverberatory furnaces, either with or without a portion of pig, or scrap, or refined iron, nor the advantage of pulverizing the ores and carbonaceous matter; but he claims the manufacture, in reverberatory furnaces, in the manner above described, of malleable iron, by means of ores and carbonaceous matter, mixed in proportions limited as before mentioned, and combined with a portion of pig or refined iron. Under the second improvement, he does not claim to have discovered the advantage of using a portion of clay or argillaceous ironstone in the manufacture of iron from certain ores, that having been previously done in the manufacture of pig-iron from such ores; but he claims the use of clay as an ingredient to be employed in a pulverized state, mixed with certain ores and carbonaceous matter, also pulverized for the manufacture, both with and without pig or refined iron, of malleable iron in reverberatory furnaces. With regard to the third improvement, he does not claim to have first applied a portion of tap or flue cinder or other silicate of oxide of iron with lime or carbonate of lime, and with iron ore, clay, and carbonaceous matter, all these having long been used in the manufacture of pig-iron; but he claims the manufacture of malleable iron from the combination of those substances, pulverized (both with and without pig or refined iron,) in reverberatory furnaces, as before described.—[*Inrolled December*, 1844.] Ibid.

MECHANICS, PHYSICS, AND CHEMISTRY.

New Saccharimetric Process. By M. Eug. Peligot.

The author communicated to the Society of Encouragement, in its sitting of the 15th April last, a process of assaying crystalized sugar, as well as sirups, by means of lime.

This process, which is applicable to sugar, in a solid or crystalized state, such as raw sugar, as well as to liquid sugar, whatever be its nature and origin, requires no other instruments or re-agents than those which are found in all manufactories and no more skill than is necessary to make an alkalimetric assay. It is based upon the action, essentially different, which alkalies exercise over the two sorts of sugar, the ordinary cane or beet root sugar, and the glucosus, or sugar from starch, raisins, and fruits.

The ordinary sugar combines with alkalies, and forms, with the bases, or chief ingredients, compounds in defined proportions, from which the sugar may be extracted without having suffered the least alteration.

The glucosus also combines with alkalies; but it produces compounds of so volatile a nature, that it is impossible to preserve them for more than a few moments. In fact, if a solution of glucose and potass be left to itself, at the ordinary temperature, the quantity of free potass contained in the liquor is observed to diminish every day, and eventually disappears entirely where the glucose is employed to excess. The glucose transforms itself, in effect, into one or more acids, which give to the liquor a brown color, and form, with the potass, neutral salts.

The action slowly exercised by the alkalies over the glucose, at the ordinary temperature, develops itself instantaneously on the solution of these bodies being boiled; in a few minutes, the transformation of the glucose into these acids takes place in a complete manner.

The alkali used by M. Péligot, for his saccharimetrical assays, is lime. It is known that pure water dissolves only a thousandth part of its weight of lime, whilst saccharine water dissolves a considerable quantity, in proportion to the weight of sugar which it contains.

To make an assay of raw sugar, 10 grammes of this sugar are weighed and dissolved in 75 cubic centimetres of water; to this solution is added, by degrees, 10 grammes of slack lime, sifted and prepared in a glass or porcelain mortar, and beaten for about eight or ten minutes; then the mixture is passed through a filter to separate the undissolved lime, the chief ingredient having been employed to excess.

It is advisable to pass the liquor a second time through the filter, in order to be able to dissolve the whole of the lime which combines with the sugar. Then take, with a graduated measure, 10 cubic centimetres of the solution of saccharate of lime, diluted with from 8 to 10 decilitres of water; then pour into this liquor a few drops of blue litmus, and saturate it with a solution of sulphuric acid. A quart of this proof liquor contains 21 grammes of sulphuric acid to 1 equivalent of water. A quart of this liquor will saturate the quantity of lime dissolved by 50 grammes of sugar.

The first solution of sulphuric acid is introduced into the alkalimetric assay vessel, or into a vessel graduated to cubic centimetres, each of which is divided into 10 parts. This vessel being filled up to zero, the acid liquor is poured into the alkaline solution, which is kept in agitation until the blue tint of the latter turns to red, under the influence of the last drops of the proof liquor.

By observing, on the divisions of the vessel, the quantity of pure acid which it was necessary to employ to attain this point of saturation, the quantity of lime and likewise of sugar contained in the solution of saccharate of lime is given:—the total contents of this solution is also known, by means of M. Payen's table for estimating the volume produced by specific weights of sugar and water.

For the ordinary raw sugars, destined for refining, the assay stops here; but it often happens that it is adulterated with *glucose*. In order to detect this fraud, and likewise to analyze the molasses and the sugars of inferior quality, proceed at first in the manner indicated for raw sugars.

After the first alkalimetric assay, introduce into a medicine phial a portion of the alkaline liquid, heated to 100 degrees, in a vessel of hot water, for several minutes. If this liquor contains only the saccharate of lime, produced by the ordinary sugar, it becomes troubled by the action of the heat, owing to the property possessed by this calcareous compound, of coagulating when heated to 100 degrees; but this agitation ceases by the cooling of the liquor, which does not assume a deeper tint than before it was heated. In submitting it to a second alkalimetric process, after it has cooled, it returns to its primitive state.

But if the saccharine produce contains glucose, the solution heated by the hot water assumes a brown tint, and it leaves a brown deposit, which does not disappear after its cooling. If the glucose is in large quantity, it throws out a decided smell of burnt sugar. Lastly, the second alkalimetric assay gives a less quantity of lime than the first; this quantity appertains entirely to the ordinary sugar, the lime dissolved cold having produced neutral salts, on which the pure liquor of sulphuric acid has no action.

When heating pure glucose, the first alkalimetric assay, after the lime has been ground with the liquid in a cold state, would produce nearly the same alkaline proportions as ordinary sugar; the second assay, made with a portion of the liquor, heated to 100 degrees, would produce the same quantity of lime as that which was dissolved by an equal volume of pure water. This quantity is very small, and will saturate 4 cubic centimetres of the pure solution of sulphuric acid per decilitre.

Although the liquor assumes a brown tint, the point of saturation may be easily determined by adding thereto a little more litmus, and stopping immediately, the solution, which has become of a greenish tint, assumes a clearer hue by the addition of sulphuric acid.

The assaying of saccharine liquids is carried on in the above manner; it is only necessary to have the precaution to operate on liquors marking 6 or 8 degrees on the areometer of Beaumé.

The juice of beetroot and sugar possesses these properties. The quantity of slack lime employed in these liquids should be almost equivalent to the presumed quantity of sugar in the produce to be assayed: this quantity is shown approximatively by the areometric degree of the liquor. Lond. Jour. of Arts and Sci.

On the Manufacture of Gas for Illumination from Water. By M. Jobard.

[From the Bulletin du Musée d'Industrie.]

A certain quantity of carburetted hydrogen gas, suitable for illuminating purposes, may be produced by the distillation of coal, rosin, fatty matters, and oils; but at the same time, a considerable quantity of hydrocarburets of hydrogen is produced in the form of tar, napthaline, paraphine, pyrogenous oils, &c., which are deposited in the apparatus, either in a liquid or solid form.

Now these substances, which are rendered useless and injurious to the manufacture of the gas, by the present mode of operating, are precisely those which are the most rich in illuminating properties. It has, therefore, been proposed to dissolve these hydrocarburets in hydrogen gas possessing no illuminating properties, and thereby rendering it capable of affording light, as the carbon is the source of the illuminating power. The whole of the year 1833 was devoted to experiments for this purpose, and to the production of apparatus for charging with carbon the hydrogen gas produced by Dobereiner's lamp.

These experiments were successful beyond expectation, and the result was laid before the Royal Academy of Brussels, upon which they appointed a commission to inquire into it, by whom the following report was presented in the sitting of 4th January, 1834:—

"The commission appointed at the last meeting, to examine the effect of the lamp constructed by M. Jobard, now presents its report, from which it appears that the commissioners are convinced that the gas burnt with a very white and brilliant flame (equal to 36 candles of six to the pound,) and that, being desirous of ascertaining its illuminating power, by a comparison of the shadows, they find that the light of this gas, issuing from a 12-hole Argand burner, is at least double that of the coal-gas furnished by the Brussels Gas Company when burnt in a 12-hole Argand burner, pierced with holes three times the size, which are employed for lighting most of the shops in this town. These observations appear completely to answer the questions put by M. Jobard to the Royal Academy.

"In order fully to appreciate his invention, it should be worked on a large scale, and an account kept of the economy effected, which he could not communicate to us without making us acquainted with his mode of operating, and which he wishes to keep secret."

The commission being desirous of seeing this invention worked on a larger scale, I had a gasometer constructed, and burners placed in every apartment in my house; a single burner was sufficient to light the largest room brilliantly, and a saving of several centimes was effected for each burner: this resulted from sulphate of iron being produced during the operation. The gas was charged with carbonaceous vapors by passing it through a cylinder containing about two quarts of oil of gas-tar, which was not exhausted at the expiration of eight days, during which time the experiments were continued. I think it right to enter into all these details for the benefit of those persons who might feel desirous of taking up this invention, which is on the eve of becoming public property.

Some doubt still remained as to whether the gas would retain the illuminating power after being confined in gasometers and traversing a considerable length of pipe; it appeared to me that very likely, in winter-time, the carbon mechanically combined with the gas, might become disengaged and deposited.*

The following fact, contained in Thenard's Treatise on Chemistry, was sufficient to put me in the right path:—*Gases combine at the moment of formation.*

A brevet was taken by me in Belgium for the production of hydrogen gas, by the decomposition of steam in vertical retorts, filled with incandescent coke, and for uniting this gas, *at the moment of formation,* with hyper-carburetted gas produced by the distillation of fixed oils, or any other hydro-carburets. I afterwards went to Paris, where, by deed, I gave up my invention to Messrs. Selligue and Tripier, in consideration of the sum of 10,000 francs and a third of the profits, on condition that M. Selligue should pass as the inventor; and as such he received the large gold medals from the Society of Encouragement and the Academy of Industry. He was about to receive the gold medal at the exhibition of 1839, and also the Cross of the Legion of Honor, for what Baron Thenard called *this splendid invention,* when I was summoned before a jury to declare the truth.

It was useless to dissemble before a jury composed of such men as Baron Thenard, Gay Lussac, Brongniart, Darcet, Dumas, Payen, &c. I simply shewed my Belgic brevet, our agreement, and M. Selligue's receipt. The case was not long in being decided; the Selligue gas, and also the Selligue system of sinking wells, which I had given up to him by the same agreement, were both deprived of their false name at once.

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* This was the case in winter-time at St. Vallier, near St. Etienne, in the manufactory of Messrs. Chareten & Son, lighted by 240 burners.

Mr. Selligue has, however, contributed his mite, for he constructed several horizontal furnaces, which would not work, before he adopted my vertical plan, and which worked successfully at Antwerp, the description of which will be given hereafter.

The towns of Dijon and Strasburg, and two of the fauxbourgs of Lyons and Paris had been for some time lighted with this gas, which, after being opposed for some time by powerful continental gas companies, was on the point of sinking into oblivion, when it was taken up in Dublin and even in London.* It was with great pleasure I saw it come into use in that country, abounding with coal, as I thought it would only be used in those countries where coal is scarce and dear; a plan was then adopted in Paris, which I had previously proposed, and which consisted in causing gas obtained by the decomposition of water, to take up hydro-carburets produced by the distillation of coal gas, at the moment of its formation. Twice or thrice the quantity of illuminating gas could be obtained by this means than by the ordinary method. The illuminating power of ordinary gas might also be easily doubled by passing it through a vessel filled with carburets of hydrogen, slightly heated, as described in my brevet.

By combining pure hydrogen gas, at the moment of formation, with coal-gas, charged with an excess of carbon, the necessity of purifying it is done away with, as the ammonia and sulphurets of hydrogen liberated are dissipated and lose their intensity; but by employing oil of schistus, or fish, or other oil, any purification will be unnecessary; this is, therefore, another advantage.

Being desirous of making the public acquainted with the advantages of this new system, and not having any further interest in the matter, I think it right to state the reasons which were given in opposition to it, by publishing the report read by M. Arago, at a meeting of the Academy of Sciences, December 3rd, 1838.

I will also refer to the Bulletin of the Society of Encouragement of the same year, for the report of Messrs. Dumas and Payen, in consequence of which, one of the grand prizes of the Society was granted to M. Selligue.

In the following year a patent was taken in England, in the name of M. de Val Marino. About the same time, this invention found its way into Austria, and fell into the hands of M. Offenheim, by whom it was offered for sale in Belgium to the inventor himself, with whom M. Offenheim was not acquainted.

To return to the explanations presented to the Academy of Sciences —they are as follows:—

Hydrogen gas is charged with carbon by passing it through a hollow cylinder, *heated to redness*, where it meets with highly carburetted oils. A chemical combination, and not merely a mixture, then takes place, as is proved by the analysis of M. Peligot, Professor at the Polytechnic School, which was as follows:—

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* Gas made from water was used in Dublin by Mr. Kelly, of Upper Gloucester-street; in London, by Mr. Stones, of 25, Golden-square; and under the arches of Waterloo Bridge.

Carburets of hydrogen,	57
Oxide of carbon,	28
Free hydrogen,	15
	100

The theoretical question of illumination is therefore as follows:—

"*What is the process which will produce the largest quantity of light from 1 lb. of either oil, resinous matter, schistus, or coal-tar?*

"One pound of oil of rosin or schistus produces in the new apparatus 35 cubic feet of gas, 3 feet of which are burnt in an hour in a burner giving a light equal to ten candles, which is equal to 23 hours light. Now, at Belleville, Antwerp, Frankfort, and wherever gas has been manufactured from *oil of rosin,* and from pure rosin, the average quantity produced was from 7 to 9 feet for every pound of oil, but in three or four days it fell to from 6 to 8 feet. Separate experiments with new retorts may furnish from 12 to 13 feet, and the production of this quantity has been announced by M. Tailleberg as a grand discovery. Let us take this quantity, although it is nearly double the average; two feet and a half of this gas must be burnt per hour to furnish a light equal to ten candles, according to a report upon the lighting of the town of Antwerp, in October, 1837, with rosin gas, and in October, 1838, with gas made from water. Let us only reckon 2⅓ feet;—1 lb. of oil therefore furnishes 6½ hours light, and admitting 17 feet for every pound to be the product, which cannot be obtained without the addition of water, it would even then only give 15 hours light, whilst the water-gas furnishes 23."

But there are other facts which can be proved without dispute. The production of gas from water does not stop at 35 feet per pound. By augmenting the quantity of water with respect to the oil in the apparatus, the gas becomes weaker and weaker, until its density approaches and even exceeds that of coal-gas. In experiments made with more than 1500 cubic feet, and watched for several consecutive hours, the rate of production was 111 feet of gas for every pound of fish oil (oil of schistus produced exactly the same result.)

It was only necessary to burn 6 feet of this gas in order to produce a light equal to 10 candles, which was but in a very slight degree less brilliant than coal-gas. Gas produced at the rate of 55 feet per pound of oil of schistus gave a consumption of 4 feet in the same burner. Thus, supposing the water-gas to be produced at the rate of 80 feet to the pound, it is equal in power to the coal-gas, and burns but 5 feet per hour. One pound of oil will therefore give 20 hours light. Let us reckon the cost of this illumination with oil of schistus, which only costs about 2*s.* for every 100 lbs., and a consumption of combustibles which is diminished in proportion to the quantity of gas produced and the size of the apparatus; whilst, on the contrary, with rosin gas, as the decomposition of the gas takes place on the surface of the metal, the small retorts are the most advantageous; and, at the same time, the mass of gas produced is not augmented, but simply its volume, and this only by decarburating the richest portion of the carburets of hydrogen, by the action of a higher temperature.

The indefinite augmentation of the light obtained from the water-gas, in proportion as it is produced weaker or stronger, tends to prove that the presence of oxide of carbon augments the illuminating power of gas, no doubt augmenting at the same time the quantity of heat developed during combustion.

I shall not, therefore, be accused of exaggeration when I state that there is some value in a process, the principle of which is to decompose water, a substance of no value, by means of coke, which is of very little value,—as under this process, 1 lb. of oil, which costs a halfpenny, will supply a burner giving a light equal to ten candles, during twenty hours. Ibid.

The Staffordshire Potteries.

Pottery is one of the most ancient and characteristic branches of national industry; we know of no product of mechanical ingenuity so early discovered as the potter's wheel, and in the Eastern hemisphere its use appears to have been almost universal from a date lost in the darkness of remote antiquity. Some forms of the fictile art were known to the natives of America before that continent was discovered by Columbus; but, though the wheel seems to have been unknown, a simple contrivance was employed which was no bad substitute; it was simply a stick which the workman held by the middle and twirled round inside whatever vessel he fabricated, to ensure its circular form. The Egyptians were probably the first who attempted to apply the Decorative Arts to their productions in earthenware; but the Greeks soon surpassed them in this respect, for they sought ideal beauty in form and color as well as in ornament. Their colonies in Italy still further extended the manufacture and the range of decoration: while the Etrurians established a school of Art of their own, which attained in its peculiar branches the highest degree of perfection.

Without entering on the history of pottery in modern times—a subject too important to be discussed incidentally—we may notice that most of the European nations have been anxious to cultivate this branch of manufacture, and that even monarchs have not thought the production of porcelain unworthy their attention. In England, where everything is left to the exertions of the people, and nothing is derived from the protection or patronage of the Government, the development of the production of porcelain and the finer kinds of earthenware has been equally spontaneous and extraordinary. Wedgwood was to this branch of industry what Arkwright was to the cotton trade; he lived to see the fictile art brought to high perfection, and to see that his success had stimulated worthy rivals to emulate him in extent of production and beauty of the article produced. Unfortunately the similarity extends further: the mills held by the descendants of Arkwright are about the worst in the kingdom, and the successors of Wedgwood in the works of Etruria do not continue, much less extend, the production of those works of high Art which first gave celebrity to their house. It may be said, and it has been said, that the manufacture of coarser and cheaper articles is more lucrative than the production of vases and figures; that the sale of articles of luxury depends mainly on the caprice of fashion; and that the demand for copies of the antique must necessarily be very limited, as it requires a cultivated classical taste to appreciate their merits. But the advantages of the reputation acquired by a house for superior artistic productions must not be measured by the immediate pecuniary returns. The character extends to all their productions: the merit of the figure castings at Coalbrookdale is received by the world as a pledge for the excellence of their gates, umbrella-stands, and other articles of domestic utility. And it is justly so received; every operative in an establishment feels strongly the duty of maintaining the reputation of the house: taste is diffusive in its nature; "a little leaven leaveneth the whole lump."

The national importance of the Potteries in a commercial point of view is not yet thoroughly appreciated; they call into exercise large powers of chemical analysis and mechanical ingenuity; they develop largely the artistic faculties; they bring into action masses of intellect which would otherwise have lain dormant and useless to the country. Our export trade in earthenware is steadily on the increase, and is capable of almost unlimited extension.* At home, comfort and convenience have been wondrously increased since ware has superseded pewter; and the sanitary condition of the community has been benefited by the improvement. Never yet did manufacturers seek for beauty without finding that they advanced in economy and utility as well as in excellence.

The days have gone by when the higher branches of Industrial Art depended for their progress upon the patronage of princes or of nobles. Henceforth improvers must look for their reward to the people, and through the people to the world's markets. It is for this reason that we have undertaken this series of articles;—articles which have imposed upon us more toil, more care, and more expense than we could possibly have anticipated when the series was commenced. But it is of importance that the English people should have some knowledge of the nature and extent of their own commercial resources, for without such knowledge they can never properly appreciate their national interests. Had such knowledge been previously disseminated, we should have escaped many embarrassing discussions, which have distracted the attention of the country and interfered with the steady progress of society. The state of THE POTTERIES requires some preliminary explanations belonging rather to the mechanical forms of production than to questions of Art; but the two subjects are so very closely blended that we deem the one necessary to the correct appreciation of the other.

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* From the weight and bulk of the pottery goods, they are eagerly sought as freight, and shippers regularly canvass for their transit. The prices at which they are conveyed to all parts of the world are, consequently, astonishingly low; in some cases they appear almost incredible: for instance, a crate of goods which would cost 4s. carriage from the Potteries to Liverpool can be conveyed from that port to America for 6s.

The discovery that the ductile argillaceous earths could, by the action of fire, be made to retain the endless diversity of forms they so readily assume under the hand of the potter, seems to have been made by almost all nations at a very early period in the history of their civilization. The relics continually brought to light among the ruins of past glory, in every quarter of the globe, give convincing proofs of the universality and antiquity of this art. The cause of the earthenware manufacture fixing itself in this locality is obvious—colored marls and clays of which the early pottery was made, and an abundant supply of coals to *fire* them, being procurable on the spot, in any quantity.* The early potters required nothing more. That its origin dates from a very remote period—some contend as far back as the Roman possession of Britain—there can be no doubt. † We have conclusive proofs, however, that, two centuries ago, earthenware was made here to a considerable extent; and from such evidence we may infer that the earlier productions of the district were notorious and extensively used. About the time we speak of, the moorlanders of the surrounding country had established a trade in butter, which they sent to London and other large towns, and their neighbors the potters supplied them with tall and narrow cylindrical earthen vessels called "butter-pots;" as the readiest and cheapest packages for the article. In 1661, an act of Parliament was made to regulate the size and weight of these butter-pots, to counteract the nefarious practices of certain "little country moorlandish cheats (than whom no people are deemed more subtle,") as Doctor Plott says. These pots were made of the common brick clay of the neighborhood, the workmanship being of the rudest character, and each jar bore an official stamp.‡

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* At the present day the finer materials required for pottery purposes are brought from considerable distances. The flint is from Gravesend and Northfleet, 650 miles; various clays and stones from Cornwall, Devon, and Dorset, varying from 300 to 460 miles. These distances are reckoned by water carriage to Liverpool, from which place the materials are conveyed to the Potteries by canal, thus adding another 50 miles! The chert-stone, for the grinding-mills, is from Wales. Gypsum, which yields the plaster of Paris of which the moulds are made, is from Derbyshire. The cost of transit is heavy: for instance, the clay which in Cornwall sells at 18s. per ton, costs in the Potteries from 36s. to 38s. China clay—in Cornwall, 27s. per ton; Potteries 43s. 6d. Devon and Dorset blue clay—in Cornwall, 18s. per ton; Potteries 36s. Black ditto, Cornwall, 12s.; Potteries 27s. per ton.

† The Roman glazing appears to have been a compound of varnishes; and Pliny is of opinion that it was made of bitumen. He affirms that it never lost its surface and beauty, and that it had become customary to glaze even statues in this manner. As the varnish sank deep into the substance of the ware, it was not subject to cracks or flaws, and, as it was not liable to corrosion by the use of acids, was free from the objections urged against the use of vessels glazed with lead.

‡ The quantity of goods made at that time was so small that Dr. Plott says, "The chief disposal of them was to poor cratemen, who carried them on their backs all over the country." Such was the rudeness of the district at this time that, according to Shaw, "all the clays and most of the coals for the twenty-two ovens weekly filled in with the different kinds of ware (crouch, black, mottled, cloudy, &c.) were obtained *from holes in the streets and sides of the lanes!*" many of which were still open in 1829, when his history was published.

No part of the history of pottery is more obscure than that of the origin and progress of "glaze," by which is meant the semivitrified surface spread over earthenwares, which at once gives it a lustrous exterior, and renders it impermeable to water. On some of the ancient vessels of the south of Europe and of Asia there are found some traces of a glaze so exceedingly thin that it is almost impossible to determine its composition even by approximation. The French chemists believe it to be a silicate either of iron or of lime rendered soluble by a silicate of soda in an inappreciable proportion. Half a century ago Chaptal proclaimed that no trace of lead, copper, or tin was to be found in the "glaze" of any earthenware fabricated before the thirteenth century; and Mr. Aikin, the best English writer on the subject, adopts the same opinion, and further suggests that some of the lustrous surfaces previously described as glazed might have been produced by mechanical polishing. But there is indisputable evidence that plumbiferous glazes were employed by the Chinese, the Arabs, and other Orientals at a much earlier period, though not, perhaps, so frequently as the silico-alkaline glazes. From the very varied proportions of the lead in the different specimens which have been subjected to a rigid analysis, we are disposed to conclude that they have been the result of tentative processes, and that the lead might have been first used merely as a flux.

Nearly all writers on the subject ascribe the invention of the plumbiferous and vitreous glaze to Stezlstadt, a potter of Alsace, in or about the year 1283. The only authority we can find for this assertion beyond tradition is the following passage in the Annals of Colmar. "Obiit figulus Stezlstatt qui primus in Alsatia vitro vasa fictitia vestiebat;" that is, "This year (1283) died the potter Stezlstadt, who first, in Alsace, covered earthenware with a glaze." To us this passage seems to indicate merely that he introduced the process into Alsace, not that he was the original inventor. We are the more confirmed in this opinion from having seen the fragments of two vases taken from a tomb in the ruined Abbey of Jumiéges, bearing the date A. D. 1120, which were indisputably covered with a plumbiferous glaze. Passeri, to whose authority we think that sufficient attention has not been paid, declares that plumbiferous glazes were used at Pesaro, in Tuscany, A. D. 1100; but it is not easy to understand what he means by the phrase "chalk of lead," which he describes as the principal material, unless it be the ordinary white lead of commerce. From the great commercial intercourse between the cities of Tuscany and the Saracenic settlements in Spain, we may reasonably conjecture that this manufacture was introduced into Europe by the intervention of the Arabs, who probably derived it in the first instance from the Chinese. *

The encaustic tiles found in the ancient abbeys of England and Ireland, to which so much of public attention has recently been directed, are unquestionably covered with a plumbiferous glaze; but, from the arabesque character of the ornaments, we are led to conclude that they

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* In confirmation of these views it may be mentioned that the term "sagger," the case in which articles are placed to be fired, is clearly derived from סגר, "sager," which both in Hebrew and Arabic signifies "to shut up" or "enclose."

must have been imported from Spain. Their date appears to range between the thirteenth and sixteenth century, and there is no trace of any manufacture of glazed or enamelled ware having existed in England until a much later period.

It is uncertain when tin was substituted for lead in the metallic glazes. The first specimens of the stanniferous glaze of which we have been able to find any record were used to decorate a pleasure-house erected by Francis I in the Bois de Boulogne: they were wrought by an Italian, Girolamo della Robia, the nephew of a celebrated potter, named Luca. Passeri mentions this potter, and obscurely intimates that he made some discoveries in the composition of glazes; and Brogniart, without citing his authority, asserts that this Luca, whom he calls the grand uncle of Della Robia, was the inventor of the stanniferous glaze.

We know of very few specimens of copper being used in the metallic glazes: the most definite and remarkable have been brought from Japan, and are in the Museum of the King of Holland. The commercial jealousy of the Dutch prevents these from being subjected to any scientific analysis; but we should recommend some tentative experiments to be made on the application of copper to glazing, as we doubt not that it would lead to some beautiful and unexpected results.

The earliest glaze employed in England was that of pulverized lead ore, first used about 1670; but it was soon superseded by the salt glaze, which was discovered by accident. A farm servant was boiling a powerful lye of that article for culinary purposes. During her temporary absence the liquor boiled over, and formed a smooth glassy coating on the outside of the earthen vessel which had contained it. The application of this discovery is said to have been made by the brothers Elers (of Nuremberg), who began business as potters at Burslem in 1690. Their works were small, and the operations conducted with strict secrecy, every man being locked up in his workshop and subjected to the rigid surveillance of the principals; but, finding it impossible to evade the stratagems employed to discover their secrets,* they removed to London, and established the Chelsea Pottery about 1720. This glaze was discontinued in the latter part of the last century.

Since the period referred to we are able to trace clearly the very numerous changes and improvements to the present time. It is certain, then, that the original importance of the district in connexion

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* One trick of many was the following:—A potter of the name of Astbury feigned idiocy, and got admission to the works. His apparent infirmity placed him above suspicion, and he was employed to tread the lathe, the construction of which he studied by day, and made a model of it at home in the evenings! This dissimulation strange as it may seem, was kept up for two years, when Astbury, having made himself acquainted with every process that seemed desirable, quitted his employers, and soon began potting on his own account.

As a pendant to this anecdote we may add the following:—About the year 1720 a potter traveling to London discovered an ailment in one of his horse's eyes. At Dunstable he called the attention of an ostler to the circumstance, who readily set about curing it, for which purpose he put a common flint stone into the fire, and, having calcined and reduced it to powder, he blew a portion of it into the diseased eye. The whiteness of the powder attracted the traveler's attention, and he resolved to test its applicability to the purpose of his business. The result was emiwith potting arose from its richness in native clays, of which it possesses great variety, of high ductility and tenacity; but these are all colored, mostly very dark, and not one particle of them now enters into the composition of the famed productions of the Staffordshire Potteries. At an early period, the orange, blue, and other light-colored clays were reduced by mixture with water to slops, technically called *slips*, and used in ornamenting the dark brown bodies; and when it was discovered that Devonshire and other parts of England afforded excellent clays of pure white, these were imported to be employed in a similar manner—merely as *slips* for ornamentation. At the present day, however, the potter, in all cases, requires this virgin white clay, which he compounds and colors at pleasure; so that it has entirely superseded, for the *body*, the material it was introduced to *decorate*. Still, since, in the gradual advancement of the art, it was found necessary to expose the ware to intense and long continued heat, and the practice was adopted of enclosing it in large cylindrical earthen vessels of great thickness, as safeguards, called "saggers," the common marls and clays remain indispensible for the construction of these vessels. Another important requisite—fuel—had, doubtless, great influence in fixing the earthenware manufacture on this spot, for the district of the Potteries is placed in the very centre of the great North Staffordshire coal-field. *

The history of earthenware manufacture in England is so closely associated with that of one great mind as to be almost inseparable from it; not merely because the manufacturer owes to him its advancement in the substantial qualities of tenacity and durability, but also its alliance with Art, and that of the highest order;—we allude to Josiah Wedgwood, who in the latter half of the last century, to quote from the memorial on his tomb, "converted a rude and inconsiderable manufacture into an elegant art and an important part of national commerce." His beginning in 1760,† was humble enough:—Making knife handles, tiles, &c., in which articles it appears he did what is called "a good business," so good, indeed, as to induce him to take a second manufactory, where he advanced to the fabrication of white stone ware, with figures in relief. His success was so great that he

nently successful. "Other potters soon discovered the source from which the superiority was derived, and did not fail to follow his example. For a considerable time they pounded the flint stones in private rooms by *manual labor*, but many of the poor workmen having suffered severely from the dust of the flint getting into their lungs and producing coughs, consumption, and other pulmonary diseases, and the demand for the powder daily increasing, they were induced to try to grind it by mills of various constructions, which, succeeding, became afterwards exclusively adopted." Thus by accident was suggested another important improvement—the use of flint.

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* It is worthy of remark that the coals lie nearer to the surface than in any other part of the kingdom; the coals in some of the pits being actually drawn up an inclined plane.

† In this year, 1760, "to supply persons of wealth and taste," a kind of white ware was imported from France. This ware, it seems, was very superior to any at that time made in England—the sole attention of our potters being given to the production of a cheap article, without reference to elegance of form and neat execution. This seemed to threaten the very existence of our manufacture, and led Wedgwood to a series of experiments which resulted in the invention of "a kind

subsequently engaged a *third* manufactory, and opened a warehouse in St. James's-square, London, where he took a partner named Byerley, a gentleman of taste and talent, through whose acquaintance with persons of wealth he procured the loan of valuable works of Art. Sir W. Hamilton supplied him with specimens from his collection of Herculaneum vases, &c. Many of his copies equalled the originals; and so rapid was his progress that he soon found himself on the highway to fame and fortune—both of which he acquired. *

Wedgwood saw from the first that it was by prosecuting potting as an art that success must be gained, and he wisely called to his aid men of genius whose remuneration was as liberal as the enterprise which engaged them was enlightened. Of these the chief was the great and good Flaxman, to whose co-operation Wedgwood was indebted for some of his finest designs. "They consisted," says Cunningham, "chiefly of small groups, in very low relief—the subjects from ancient verse and history. I have seen and examined numbers of them, and many are equal in beauty and simplicity to his designs for marble." We wonder not at Wedgwood's success: the wonder is that his example should have found few or no imitators in the district where he met with such deserved rewards. †

Many years ago, the late Mr. Enoch Wood, of Burslem, commenced the formation of a Pottery Museum—intended to show the progress of the manufacture, by exhibiting specimens of the various wares made in the district, from the earliest date up to the present time. His

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of ware wholly unique in appearance, and bearing a brilliant glaze; of compact body, possessing every requisite for its intended purpose, and made with ease and rapidity." This obtained royal patronage (in the year 1763), and was called "Queen's ware," by command of her Majesty Queen Charlotte.

* When the Barberini Vase was on sale, Mr. Wedgwood became a bidder against the Duchess of Portland; his offers exceeded those of her Grace, until the Duke, ascertaining who was the person so bidding, and the cause of his doing so, promised to lend it to him for an indefinite period if he would withdraw his opposition; thus her Grace became the owner. Mr. Wedgwood copied it, and sold, it is said, fifty of them for £50 each, to subscribers. This beautiful vase has often been quoted as evidence of the great degree of excellence to which the ancients had arrived in the manufacture of *porcelain*. It was discovered in the tomb of Alexander Severus, who died in the year 235. But this exquisite specimen of workmanship, being made of glass and not of porcelain, is no confirmation of the above assertion.

† In the passage from which the above is taken, the writer goes on to say:—"Before those days, the porcelain of England had but little external beauty to recommend it in the market. The greatest work of that kind was the famous 'Royal Oak Dish,' an immense soup plate, of nearly two feet diameter, covered by a spreading oak, with Charles, sceptered and crowned, amongst the branches,—his wig floating in vast redundance; *and every golden acorn as large as the king's head!*" "To excel such works was certainly not difficult, but Flaxman did more than excel them. The Etruscan vases and the architectural ornaments of Greece supplied him with the finest shapes, and these he embellished with his own inventions; and a taste for forms of elegance began to be diffused over the land. Rude and unseemly shapes were no longer tolerated; and the eye, growing accustomed to elegance, desired to have this new luxury at table." Flaxman, so far from being ashamed of such labors, "loved to allude to them":—an example that we hope will have the effect of breaking through the barriers which have hitherto interposed between the artist and the manufacturer. To effect this necessary consummation has for years been a great object of our labors, and that our efforts have not been fruitless, every day brings us some agreeable and conclusive testimony. For on this union, and on this alone, now depends the continuance of our supremacy as a manufacturing nation.

object, we believe, was not fully attained, but sufficient was done to show the feasibility and value of such a project. At Mr. Wood's death the collection passed into the hands of his son; and as circumstances much to be regretted, have occurred which render it likely that the collection will be disposed of, we earnestly hope it may come into the hands of some public institution—perhaps the British Museum.

The wares made in the Potteries are of many kinds, but the principal are comprehended under three heads. First, the common ware, made of the native marls and colored clays; and these are now used for the commonest domestic purposes, for flower-pots, &c. The second comprises earthenware of a superior quality, made from the white clays of Devon, Dorset, and Cornwall,* compounded in various ways (almost every master potter having his own *secret*); all the wares of this class are of an opaque body. The third consists of porcelain (locally called *china*), the best kind of ware, being exquisitely fine in texture and semi-transparent; it was made at the Chelsea Pottery, London, nearly half a century before its introduction into the Potteries, which took place about 1765, at Burslem; but, not being at first encouraged, it was discontinued for a while, probably in consequence of Wedgwood's "Queen's ware" being then the fashion. About 1767, the first application of PRINTING from copperplate engravings was made. The process was invented and first applied by a Liverpool engraver, to whom the ware was sent for ornamentation by that mode. The color originally employed was blue, and it was the *principal* if not the *only* color used, during many subsequent years. The first complete printed table service, made in England, was, we believe, in 1780. The pattern was the famous and execrable Willow.

Our object is now to explain the necessary care with which THE POTTER'S CLAY IS PREPARED. First, in the preparation of the two principal ingredients—flint and natural clay; and afterwards in the blending of them together. The flint stones are first calcined; this is effected in a kiln similar to that used for lime-burning. These stones are spread with alternate layers of coal, and the burning is usually completed in about twenty-four hours. They are then white and very brittle, and ready to be crushed by the "stamper"—a machine composed of upright shafts of wood, six feet long and about eight inches square, heavily loaded with iron at the lower end, which, by means of other machinery, are made to rise and fall in succession on the flint, contained in a strong grated box. It is then removed to the GRINDING vats, which are from twelve to fourteen feet in diameter, and four deep, paved with chertstone, large blocks of which, being also worked round by arms connected with a central vertical shaft propelled by an engine, become a powerful grinding medium. This peculiar stone is used because of its chemical relationship to the flint, which, therefore, suffers no deterioration from the mixture of the abraded particles which necessarily result from the friction—a matter of serious consideration. In these vats the flint is ground in water until it attains the consistency of thick cream, when it is drawn off, and conveyed by troughs into the washing-chamber. Here it undergoes a further purification : more water is added and it is kept in a state of gentle agitation by means of revolving arms of wood, thus keeping the finer particles in suspension while the liquid is again drawn away in pipes to a tank below. The sediment is afterwards reground. The cleansing process is not yet complete, for when the flint has passed into these tanks, to about half their depth, they are filled up with water, which is repeatedly changed until the flint is considered sufficiently fine and free from all foreign matter. It is then fit for use. The clay of course requires no grinding. It is received from the merchant in lumps of from five to ten pounds each, and sometimes in a dry state in casks. When required for use it is worked with water in a similar manner to the flint, until it attains the same degree of fineness and fluidity. The next stage is the MIXING; for which purpose the different slips (*i. e.*, the fluid clay is so termed, technically) are run off successively into the blending reservoir, against the inner side of which are gauging rods to regulate the quantities of each to be admitted. The mixture is now passed into other reservoirs, through fine sieves, or lawns, woven of silk, and containing 300 threads to the square inch. * Finally, the slip is conveyed to a series of large open kilns, heated underneath by means of flues, and about nine inches deep. This is to evaporate the superfluous moisture, which is generally effected in twenty-four hours, by which time it becomes tolerably firm. It is then "cut into large blocks and conveyed" to an adjoining building, to undergo the process of MILLING. The mill is of iron, in the form of a hollow cone, inverted, with a square aperture or tube at the lower part. In the centre is a vertical shaft set with broad knives. When this shaft is in action, the soft clay is thrown in and forced downwards, being alternately cut and pressed until it exudes from the aperture at the bottom in a perfectly plastic and smooth state. It is now ready for the hand of the potter.

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* The Cornish clay is the best quality, and is technically termed by potters China clay, and enters very extensively into the composition of the best kind of ware. It is the decomposed felspar of the granite, and is prepared by the clay merchants themselves in Cornwall prior to its being sent to the Potteries. Huge masses of white granite abound in Cornwall, which is in some parts found partially decomposed; and where this is the case the mineral is raised and prepared for the potter's use, it having been discovered by Mr. Cockworthy of Plymouth, in 1765, that it furnished the true "kaolin," and also the "petuntse" of the Chinese.

The following is the method of preparation:—The stone, having been broken up by a pickaxe, is laid in a stream of running water; the light argillaceous parts are thus washed off and kept in suspension; the quartz and the mica, being separated, are allowed to subside near the place where the stone was first raised. At the end of these rivulets are a kind of catchpools, where the water is at last arrested, and time allowed for the pure clay with which the water is charged to separate from it, which being effected the water is drawn off; the clay is then dug up in square blocks and placed upon a number of strong shelves called "linnees," so fitted as to allow a circulation of air in order that the clay may be properly dried. Thus prepared it is extremely white, and in the state of an impalpable powder. It is then forwarded to the Potteries under the name of China clay.

Some of the Cornish granite itself is often used with the clay, on account of its binding quality, it being naturally more fusible than the earths usually employed; for it is a remarkable fict that neither clay, silica, nor lime will melt singly; but by mixing these three species in due proportions the greatest degree of fusibility is attained.

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* A pint of "slip" of Dorsetshire or Devonshire clay weighs 24 oz. of proper consistence ; a pint of slip of Cornish clay, 26 oz. ; and of flint, 32 oz.

The preparation of porcelain clay is similar, but more complicated, and involves more serious risks. The qualities necessary in good porcelain are—a sound compact body, white, semi-transparent, and capable of bearing a rich and shining glaze; not liable to discoloration or "crazing," and being proof against sudden variations of heat and cold. The qualities in which porcelain differs from earthenware are those which are most difficult to realize; and the production of excellent specimens of either is by no means always a matter of ease and certainty, even at the best manufactories.

(To be continued.)

On the results of an extensive series of Magnetic Investigation, including most of the known varieties of Steel. By W. Petrie.

The following is an abstract:—

Process of manufacture to produce permanent magnets, having the greatest fixity and capacity conjointly secured.—1. The original iron should be the purest soft iron, *charcoal made* (not coke;) the Swedish, from the *Dunnamore* mine, is better than any other. 2. Converted—with pure *charcoal;* it should be carbonized *lightly*, and the process to be stopped when the bars, of the usual thickness, are "*scarcely steel through*," yet so that it will harden with certainty, without an undue heat. 3. Sorted—with attention to homogeneous conversion, &c., according to the ordinary rules. 4. Melted—the pot kept covered, and not longer than is necessary in fusion. 5. Cast—into a large ingot, so as to allow of its being *well* rolled out singly, before it becomes reduced to the requisite thinness. 6. Rolled—while hot from casting, to save a second heating; it should not be doubled over, nor sheared and faggotted; the rolling should be conducted at as low a temperature as convenient, as it thereby acquires a harder, closer texture, and finer grain. 7. In cutting into shape, the substance (if large, or of varied form,) should not be strained, as by boring with "*rymers*," or straightening (oftener than is unavoidable) with the hammer, as it is then apt to warp, and to have unseen commencements of cracks on becoming subsequently hardened. More carbonization than that previously described as best is of little injury to the magnetic goodness of the steel, provided it be so prepared as to preserve a homogenous and *white* appearance of fracture when hardened, which is not so easily managed as with that of lower carbonization; but if it be again carbonized *more* than usual, (as razor steel, or above that,) it rather improves; and again an increase deteriorates it as in cast iron, and a further increase again improves it. In short, *in the scale of carbonization there is a succession of continually decreasing maxima of advantage.*

On the physical properties which the steel should possess.—The fineness of grain is affected by many adventitious circumstances, which must be considered and allowed for in judging of it; and the most important fact is the difference between the appearance in the *hard* and *soft* states; for in the general properties, whether optical, mechanical, or magnetical, their order, in any set of samples, is *reversed* in the hard state, independently of the absolute change in each property. The steels should be examined by breaking with a *single* bend at a file notch (notching with a chisel, bending back, &c., change the appearance.) A microscope of 6 or 10 lineal power is better than any other power for examining it. The *general* properties, without going into detailed description, should be as follows, the terms being comparative with other samples of less value, and not at all with the hard or soft states of the same steel:—

In a soft state.	*In a hard state.*
General appearance, uniform darkish grey.	Uniform white.
Rather a large grain, compared with razor steel (or finer if much rolled.)	A smaller grain than it was before.
Rather irregular in size and shape of grain unless fine. Rounded crystallization.	Rather more regular than before.—*Rounded* crystallization disappears.—Grains individually distinct, with good metallic lustre.
Close texture, without cavities.	Not particularly close.
Rather tough for steel.	Brittle and very hard.
Attracted considerably before magnetizing.	Ditto.
Loses induced magnetism more freely than other steels.	Retains magnetism well and abundantly.

Care must be taken to discriminate between real cavities and indentations arising from the crystals being torn up, by the breaking; pure iron often appears porous from this cause.

Then followed some peculiar considerations on the chemical constitution and molecular arrangement of certain sorts of steel; and on the molecular peculiarities of iron and other metals, in connexion with their magnetic capacity, illustrated by a tabular arrangement.

On hardening, &c.—In the ordinary process there is risk and difficulty for large work, owing to unequal heat, unnecessary time and heat applied, especially to fine edges, decarbonization, scaling, &c. These are obviated by a process which is new, as applied on a large scale, namely, heating in melted lead. It will be observed that the *precise* heat is imparted, quite uniformly, in half a minute or so; and the finest edge is heated momentarily no higher than the thickest part, rendering this process incomparable for all instruments where it is the edge or smaller parts that are of importance. *No scale is formed,* the finest polish or sharpest edge being preserved through the hardening. The previous preparation of the steel and some other points are described; and particulars of the manner of refrigeration in water (salt) and for securing hardness and great evenness, are also detailed. The process has been applied to steel sheets of 10 inches by 20, obtained quite flat, and as hard as a file throughout, even at the middle parts, which has hitherto been found very difficult—we may say impossible. Magnets, prepared by these means only, differ generally in magnetic power by $\frac{1}{40}$ part, many being absolutely equal. Particulars are then given of the advantage of certain high powers for magnetizing bars, and of an apparatus constructed, weighing 2 cwt., and possessing nearly as great aggregate power as the colossal magnet in possession of the Royal Society (weighing, we believe, 2 tons.) A method is suggested for verifying the constancy of magneto-meteorological instruments, by means of the terrestrial magnetism itself, independently of its own variations, or of the comparison of the mutual action of three or more bars.

'On the mode of developing the Magnetic Condition.' By Dr. Scoresby.—Dr. Scoresby stated that he had, at York, shown a new and superior mode of developing the magnetic condition in properly prepared and hardened steel bars, by interposing a thin plate of soft iron between the operating magnet and the bar of steel to be magnetized. He had, at that time, supposed it to be necessary to extend the thin plate of soft iron the entire length of the bars of steel to be magnetized. But he had since found this to be by no means the case; since by laying any number of unmagnetized bars of steel in a long line, and passing along them a horse-shoe magnet with its poles connected with a thin polished plate of soft iron (he used common hoop iron), the ends being slightly bent upwards to cause it to pass more freely over the steel bars, and then turning them over and renewing the process on the other face, he found he could communicate to the bars the full charge which they were competent to receive. The Rev. Doctor exhibited this experiment; and by simply passing a horse-shoe magnet thus armed with an interposed piece of sheet iron, once over each face of twelve previously unmagnetized bars of steel, he communicated to them so much power as that they sustained their own weight, when held up as a chain.

Mr. Broun said, that if Dr. Scoresby, or some other equally competent person would turn his attention to the influence of alterations of temperature on the power of a magnet, or could discover some means of rendering the power of a magnet independent of the ordinary changes of atmospheric temperature, he would confer a benefit on persons engaged in magnetic researches. Lond. Athenæum.

Preservation of Timber, Hemp, Linen, &c., by Sir William Burnett's Method.

We have, on several previous occasions, called attention to the antiseptic qualities of chloride of zinc, as used in the patented process invented by Sir Wm. Burnett, for the preservation of timber, cordage, sail-cloth, and every article in hemp, flax, cotton, woolen, &c.; and we find that the experiments which have been continually carried on, not only establish the successful effects of its use on all materials to which it was first applied, but various other important uses for its agency have been discovered. Its effects on timber are remarkable, hardening and improving the texture, entering into perfect chemical combination with the ligneous fibre, and it never afterwards exudes through the pores, and no amount of washing or boiling can remove the chemical compound. Canvas, cordage, &c., is effectually preserved from mildew, rot, &c., without being in the least discolored, while they are rendered still more pliable. On every description of manufacture, composed of flax, silk, cotton, or wool, it has a similar effect—preventing every attack of decay, and rendering them fireproof, when the solution is used of sufficient strength. In addition to these valuable properties, it is now employed in the dissecting room, to prevent nauseous effluvia from the decomposition of the muscles during the continuance of a lecture, which sometimes lasts a fortnight or more; its action on putrid flesh is almost magical; from a certificate of W. V. Pettigrew, Esq., we find that, in February, while lecturing on the superior extremity, an arm was employed, which was quite green and highly offensive; but, by injecting the veins with the chloride of zinc, it was restored to its fresh condition, and lasted throughout the lecture, from the 3d to the 28th February; green hides are most economically treated in this way, and their offensive smell removed. Its effect on some substances held in solution in water is most powerful; and hence it has been discovered, that it most effectually removes the unpleasantness and danger of putrid bilge water on board ship. No better test can be given, as a proof of its action in this respect, than on a decoction of logwood, which it is well known, may stand for months without any precipitate taking place, but, on adding a few drops of the solution of chloride of zinc, the whole of the coloring matter is immediately precipitated, leaving the liquor clear. When the chloride of zinc has been injected into any of the substances, such as timber, canvas, &c., it becomes so chemically united, that even the saw-dust of a piece of prepared timber, when operated on by an eminent chemist, gave out only 23 per cent. of the quantity of the chloride contained. The Government authorities are so thoroughly satisfied of the importance of the process, that in addition to the tanks already in use in the various dockyards, which are 50 feet long by 6 feet diameter, four gigantic cylinders are now being constructed for exhausting purposes—they are to be 86 feet long and 6 feet in diameter, and are intended for Woolwich, Portsmouth, Pembroke, and Plymouth. The progress of railway construction in Belgium is expected to bring a considerable increase of business to the company; they have already two contracts for preparing a large number of sleepers, which will be transported hither, prepared in the works at the Isle of Dogs, and re-shipped for Belgium, free of duty—arrangements having been made with the authorities for that purpose. It has occurred to us very forcibly, that one very important use, to which this principle might be applied, has been omitted—viz: to the preservation of paper for manuscripts and printed works; it, of course, requires consideration as to the best stage of the paper manufacture for its application, but that could soon be determined by experience. It strikes us that the most effective, as well as most economical moment, would be the application of the solution to the pulp, just before passing the drying cylinders; or, for the preservation of printed works, the paper might be damped down with the solution, instead of common water. We merely throw out the suggestion.

Min. Jour.

On the Cohesive Force of Water.

In the course of a very interesting lecture, at the Royal Institution, Professor Faraday explained that water was known to us in three states—the "solid," in the state of ice, where the greatest attraction existed between its particles, and it required some amount of mechanical force to separate it—the "liquid," where its particles were less attracted towards each other, and were free to move—and the "vaporous" state, where its particles were still more further separated by heat, and possessed little or no attraction towards each other. It was of the cohesive force of water in its fluid form that he was about to speak; and it must also be remembered, that what is true of this force in water, is also of all liquids. The Professor then showed an experiment, well known as exhibiting the adhesion of water. A plate of glass is suspended from a balance over a small basin, and so accurately counterpoised by weights, that the addition of even a grain would turn the balance. If in this state water be poured into the basin, so as barely to touch the under surface of the glass plate, it is found that it will now support a further weight of 1½ ounce placed into the opposite scale. And this is owing to two forces which now come into action; first the adhesion of the water to the glass, and then the still more powerful adhesion of the particles of water among themselves. This phenomenon was, till very lately, attributed to capillary attraction; but Dr. Henry, of Princeton, conceived that it must be due to other causes, and he was induced to make a variety of experiments on the matter, and the results arrived at, proved that the cohesive force of every square inch of water is equal to several hundred pounds. The Professor next referred to the experiments of the young philosopher, Donne, which are but little known in this country. Donne has found that, where water is carefully deprived of the air in solution, it may, if there be no breach of continuity among the particles, be raised to a height of 100 feet; while, under ordinary circumstances, 30 feet in round numbers is the greatest altitude at which it can be supported. The phenomenon depends also upon the strong cohesive force residing in these particles of water when deprived of all extraneous matter, for the moment a little bubble of air is let in—that is to say, the moment a breach of continuity occurs, the water obeys the natural laws and finds its own level. The other important fact made out by the experiments of Donne, is as follows:—Water carefully deprived, by boiling, of all the air in solution, instead of boiling at 212°, the boiling point of water, under ordinary circumstances, may be raised to 275° Fahr. without showing any signs of ebullition, as long as the continuity of the particles of water is not broken. Thus, a force equal to three atmospheres, is restrained only by the adhesion of the particles of water. At the temperature of 275°, it suddenly bursts into ebullition, with a loud explosion, dashing the containing vessel into fragments. May not steam-boiler explosions be sometimes thus accounted for? The Professor lastly referred to the experiments of Boutigny; which, however, have been so often repeated in this country, as to be familiar to all students of science. The experiments of freezing water and mercury in a red-hot vessel were then exhibited, as before explained in this journal. Ibid.

Applicability of the Gun Cotton to Mining Purposes.

At the annual meeting of the Royal Geological Society of Cornwall —which was held last week at Penzance—Mr. R. Taylor gave an interesting account of some experiments made in the neighborhood of Penryn, for the purpose of testing the applicability of Prof. Schönbein's invention to mining purposes. We extract the following particulars:—One hole was charged with powder, and another with a quarter of the weight in cotton—the latter tore the rock in atoms, in fact did more than was required. They then went to another and more dense rock, and put into a hole 13½ ounces of powder; in a second hole in the same rock, 3 ounces of the cotton—less than a quarter part—was deposited, which did the work to the complete satisfaction of all present, and equal to the powder. Other experiments were subsequently made; and Mr. Taylor found that in some cases *one-sixth* of the charge of the cotton as compared with the powder did its work. In tamping, &c., the cotton was found to be all that could be desired—and Mr. Taylor was enabled to state that, throughout, the experiments were eminently successful, and that a *fourth* part of the weight of powder, in cotton, would be found to be about its strength. With regard to its effects on the air in mines, he might refer to an experiment made at Restormel Iron mine, which was not very easy of access to the adit level, which was at a great distance in the mine —they tried the cotton at the extreme end, which was some 600 or 700 fathoms from the entrance, and the lode was in hard ground. Two holes were prepared, both of which were charged with the cotton—one with a *quarter* the weight of powder usually used, and the other with *two-sixths:* the holes were fired, and the cotton tore the ground to the complete satisfaction of all present. Had the explosion taken place from powder, they would not have been able to approach the holes for at least three-quarters of an hour—but on this occasion, they all went in immediately after the explosion, and experienced not the slightest inconvenience, and all they smelt was what was emitted from the safety fuse. London Athenæum.

Iron War Steamers of Great Britain.

In the House of Commons, on Thursday evening, Mr. Wawn, in conformity to notice, asked the Secretary to the Admiralty, how many iron war steamers were being built? Also, whether any experiments had been tried as to the effects of cannon shot upon iron vessels, and if those experiments had been satisfactory or not? And lastly, whether the Government intended to persevere in building iron war steamers?—Mr. Ward, in reply, said that there were at present, 16 iron war steamers in commission, including the Dover mail-packets; there were four other iron steamers ready, not in commission, including the *Birkenhead*, of 1400 tons and 556 horse-power; and that there were seven other iron steamers building of which one, the *Simoom*, was

1953 tons, and 780 horse-power. As there had been only one experiment made of the effects of shot upon iron steamers, it would be highly improper to pronounce any opinion upon that subject; and, in reply to the hon. Member's last question, he begged to say, that the Board of Admiralty would be extremely cautious in giving any new orders; at the same time, nothing determinate has been resolved on in this respect. Lond. Min. Jour.

Effect of Cannon Balls on Iron Steamers.

At Portsmouth some remarkable results have been produced by the experimental shot practice, from the *Excellent*, on the iron steamer *Ruby*. The shots which hit the *Ruby* not only penetrated the side first struck, but in some instances passed through the other side, carrying with it whole plates of iron. In action, this would risk the total loss of the vessel; for on heeling over to leeward, such a body of water must rush in that nothing could prevent her sinking with all on board.
Lond. Mec. Mag.

Vibrating Marine Engines.

The public will be gratified to hear of the excellent performances of the Peninsular and Oriental Company's new steam-ship, the Pottinger, in her first trip from Southampton to Malta. The following is an extract of a letter from a gentleman on board, dated Malta, Oct. 2:—"I am sure you will be pleased to hear of our arrival at Malta, after a very rough passage, in which both ship and engines have been well tried, and have been found most efficient. The ship is strong, and not in the least inclined to strain; the engines are a beautiful specimen of mechanical skill. I have watched their smooth working narrowly, and there have been neither hot bearings, escapes of steam, derangements or breakings of any kind, which to me, from my little experience in steam voyages, is rather surprising. I particularly remarked, whilst off Cape St. Vincent, blowing at the time a smart gale, that the engines made 15 strokes per minute, with abundance of steam, and the bearings as cool as if the machinery was not in motion. I have no doubt the future performances of ship and engines will be as satisfactory, as all on board admit the passage, under the above circumstances, has been." The engines on board the Pottinger are by Miller, Ravenhill, & Co., of Glass-house-fields. They are the largest oscillating engines that have ever been in motion afloat—being 450-horse power, or having cylinders 76 inches in diameter, and seven feet stroke. Lond. Railway Mag.

Account of Mushet's Black Band Ironstone.

Mr. Bald read a paper, at the British Association, on the "Mushet Band," commonly called the Black-band Ironstone of the coal-field of Scotland.—This band of ironstone was discovered, about 40 years ago, by Mr. David Mushet, of the Calder Iron-Works, near Glasgow. It had been frequently passed through; but was thrown away as rubbish, till Mr. Mushet ascertained its value—when extensive mines were opened for working it. Two bands of this ironstone are found in the great coal-fields of Lanark—one 14 in. thick; the other, which is 73 fms. lower, is 16 in. thick. The ironstone of the Mushet band is much more easily reducible than the ordinary dry ironstone—and requires less fuel. In Scotland it appears to be co-extensive with the coal formation. In South Wales, also, it is found; but there is little of it in England or Ireland. Fifty years ago there were only five iron-works in Scotland, comprising above 15 blast furnaces, which, together, produced 540 tons of iron per week. There are now 100 blast furnaces in action, which produce 12,000 tons per week, or 624,000 tons in the year—the value of which, at £3 per ton, is £1,872,000. This great increase Mr. Bald attributed to the discovery of the Mushet ironstone, and to the introduction of the hot-blast. He also mentioned that Mr. Mushet, who is now in his 86th year, has published a volume on the manufacture of iron, containing an analysis of every ironstone and ore he could obtain; and he trusted his labors would, at least, be recognised in scientific societies, although the pecuniary advantages arising from his discoveries had fallen into other hands.

Min. Jour.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notice of the "Architect," a series of Original Designs for Cottages.
By W. H. Ranlett, *Architect.*

We have received from Mr. T. B. Peterson, No. 98 Chestnut street, the first and second numbers of "the Architect, a series of original designs for domestic and ornamental cottages," by Wm. H. Ranlett, Architect, New York.

Each number of this work contains six large quarto plates of buildings; the elevations being handsomely executed in tinted lithography, and the details, with the specifications and estimates, being given with great minuteness. The designs are in good taste and the price of the work is very low, being only fifty cents a number, five of which will complete a volume. We are pleased with the evidences of the awakening of a new interest in our country in the subject of domestic architecture. There is much room for improvement in this respect, and the idea that none but the possessors of great wealth can show proofs of good taste in the erection of their dwellings is a gross fallacy. The traveler in the New England states is often delighted with the sight of beautiful houses, which are real ornaments to the villages in which they stand, and which have cost less than the ugly and mis-shapen erections which frequently disfigure our towns in the interior of Pennsylvania. Such publications as the one now before us are eminently worthy of patronage, their general diffusion will do good in many ways, and while they add to the demand for the services of professional architects, they will refine the taste and increase the knowledge of practical builders.

ERRATA IN VOL. XII.

Page 340,—line 7 from top, for "*gaseous*" read "*aqueous.*"
" " " 10 from bottom, for "*reduce*" read "*increase.*"

JOURNAL

OF

THE FRANKLIN INSTITUTE,

OF THE

State of Pennsylvania,

AND

AMERICAN REPERTORY.

FEBRUARY, 1847.

CIVIL ENGINEERING.

Twentieth Annual Report of the President and Directors to the Stockholders of the Baltimore and Ohio Railroad Company.

(Continued from page 8.)

Hon. Louis McLane,
President Baltimore and Ohio Railroad Company:

Dear Sir,—In compliance with your request, I have the honor to submit a general statement of the operations of the Baltimore and Ohio railroad during the past year.

By reference to the reports of the Superintendents of transportation and machinery, it will be seen that there have been transported to and from the several points on the main stem, 193,916 tons of merchandize, and 280,264½ passengers, showing the very remarkable increase in the former of 52,509 tons, and in the latter, of 77,806 passengers over the year previous. This increase in the tonnage, it will be observed, has occurred, upon the most part, in the transportation of miscellaneous trade, and is the more gratifying, because it gives evidence of the importance attached to this route as an avenue of communication with the west, even in its present unfinished condition; and connecting, as it does, with a most imperfect mode of transportation between Cumberland and the Ohio river.

The increase above alluded to, occurred chiefly between the months of September and May last. The great drought of the summer of

1845, having rendered the Pennsylvania canals very inefficient during the last autumn, and the violent effects of the breaking up of the last winter causing them to be almost entirely useless until a late period of the spring.

This large amount of trade thrown thus suddenly upon the road, although extremely gratifying in many respects, produced considerable embarrassment on account of the inadequacy of the motive power and cars for its accommodation. To such an extent, indeed, at one period, did this embarrassment exist, that for a short time it was found absolutely indispensable to refuse to receive merchandize for transportation, the depot being crowded to its full capacity, and the forwarding houses at Cumberland being unable to procure wagons in sufficient numbers for its prompt despatch.

It will be readily perceived, that in the effort to accommodate such a trade, both the locomotives and cars were pushed to their utmost capacity, and indeed beyond what would, under other circumstances, have been considered consistent with a proper economy in regard to repairs. It not unfrequently happened that the engines, after performing their duty during the day, had necessarily to be repaired after night, in order that they might be ready for use the next morning—a system altogether too expensive, and too imperfect to be allowed, except under such circumstances as then existed. But, under this state of affairs, it became the duty of the board, to endeavor to procure, at as early a day as possible, an increase of power and cars; and they accordingly directed the committee of transportation and machinery, by resolutions of the 3d December, 1845, March 11, 1846, April 8, 1846, and June 10, 1846, to procure six locomotives of the largest class, and three of the second class; and also to cause to be constructed, in the Company's shops, one locomotive of the largest class, and one of the second class; 30 iron coal cars, 20 house cars, 42 gondola cars, and 20 stock cars.

The board, under a report and resolution of the committee of transportation and machinery, on the 8th July last, have further authorized, in view of the probable increase of the trade during the year 1847, contracts to be made for five first class engines, and 30 merchandize cars. This last authority, has not, up to the present moment, been acted upon, except in regard to the merchandize cars, which are now in course of construction. Whether the increase in the coal trade will be such as will render the five locomotives, above referred to, necessary, remains to be ascertained, and may depend upon the course the Company may take in regard to that subject. Only three of the engines, above referred to, have been delivered. One of the engines ordered to be built in the Company's shops, is in a state of forwardness, and those contracted for, will be delivered in the course of this year. Nearly all the cars ordered have been completed, and are in use upon the road. This large increase of machinery and cars, rendered further accommodation for their protection at the Mount Clare and Cumberland depots indispensable; and, under the recommendation of the engineer of machinery and repairs, the board authorized the extension and erection of the buildings and other improvements at those points, under resolutions of the 11th March, and 13th May last. These circumstances, it is believed, will sufficiently explain the increase, during the year, of expenditure in the repairs of locomotives, the cost of new machinery, and of expenditures upon depots and water stations.

The quantity of coal brought to market over the road during the year, amounts to 18,393 tons, being 2373 tons more than that of last year. It must be observed, however, that of this quantity, 12,682 tons have been transported since May last, that being about the period when several of the coal companies in Allegheny county commenced their operations. The contract with the New York and Maryland Iron and Coal Company, to which reference has been had in former reports, having been abrogated, and that Company having devoted its capital and energies to the manufacture of iron, the quantity of coal received from them during the year has been very inconsiderable.

The augmentation of the trade, and the occurrence of accidents almost daily, which involved serious derangement of the machinery, and in some instances the loss of life to persons engaged upon the trains, necessarily had the effect of calling the attention of the board to the condition of the road, and accordingly, on the 8th of October, 1845, a resolution was adopted directing the chief engineer to take into consideration and to report to the board, a system for the gradual extension and improvement of the road from Harper's Ferry towards Baltimore.

Upon this resolution the chief engineer made an elaborate report, in which it was satisfactorily shown that the condition of the road was such as to require its re-construction. The comparative merits of the plate rail and the edge rail, in point of repairs and renewals of track, repairs and renewals of machinery, and expenses upon the motive power, are very fully discussed, and the advantages are shown to be most decidedly in favor of the edge rail.

The following table, extracted from the chief engineer's report, will exhibit, at one view, the cost of construction, and the relative expense of maintaining the two descriptions of track under different amounts of trade:

TABLE OF THE COST

Of Constructing and Maintaining the two kinds of Track under the various amounts of Trade.

Description of Track.	Estimated cost of Con- struction per mile.	Interest at six per cent. on cost, per mile.	Interest at six per cent. on cost of 92 miles.	Average of 7 years, ending October 1st, 1845.				Year ending October 1st, 1846.				Year ending Oct. 1st, 1847.			
				Trade of 47,008 tons.				Trade of 116,522 tons.				Trade of 151,522 tons.			
				Repairs and Re- newals per mile.	Repairs and Re- newals for 92 miles.	Interest, Repairs, and Renewals for 92 miles.	Capital equivalent to the latter, at 6 per cent.	Repairs and Re- newals per mile.	Repairs and Re- newals for 92 miles.	Interest, Repairs, and Renewals for 92 miles.	Capital equivalent to the latter at 6 per cent.	Repairs and Re- newals per mile.	Repairs and Re- newals for 92 miles.	Interest, Repairs, and Renewals for 92 miles.	Capital equivalent thereto at 6 per cent.
Plate Rail,	$3,500	$210	$19,320	$653	$60,076	$79,396	$1,323,266	$1,019	$93,748	$113,068	$1,884,466	$1,201	$110,492	$129,812	$2,163,533
Edge Rail,	10,560	644	58,328	288	26,496	84,824	1,413,400	396	36,432	94,760	1,579,333	449	41,308	99,636	1,660,600
Difference. In favor of Plate Rail,	7,060	424	39,008			5,428	90,134								
Against Plate Rail.				365	33,580			623	57,316	18,308	305,133	652	69,184	30,176	502,933

From the preceding tabular statement it will appear that if, instead of 92 miles of plate rail, we had an equal number of miles of edge rail, the saving under the probable trade of the present year of 116,522 tons, would have amounted to $18,308, and under the 151,522 tons of the coming year to $30,173, in the maintenance of way alone. From these sums there should, however, be deducted the annual interest upon that part of the capital invested in the present plate rail track, which would be sunk by the substitution of the new track. Of the $3500 per mile, the estimated cost of the former, about $1500 would be realized by the sale or use of its materials, leaving $2000 per mile, on which the interest at six per cent. is $120 per annum per mile, and for 92 miles $11,040, which, taken from $18,308, and from $30,176, leaves $7268, as the saving for 1846, and $19,136 for that of 1847.

These results are founded upon estimates of the average wear and tear of the two tracks for a series of years under the respective amounts of trade assumed. But, in fact, while the plate rail track, if continued, would certainly cost the sums set down to it during this year and the next, the edge rail track, if now laid down and ready for use, would, for those two years, cost very much less than the amounts assigned to it. Indeed, considering the perfectly consolidated character of the road bed upon which it would be placed, it is believed that for the first year it could be maintained in repair for $125 per mile, and for the second year for $195 per mile.

In confirmation of this supposition, and in support of the above estimate of the repairs and renewals of an edge rail track like that west of Harper's Ferry, under the several amounts of trade assumed, may be adduced the fact that the H rail track, of which there are 19 miles east of Harper's Ferry, has cost an average of about $210 per annum per mile to maintain it since it was laid down, seven years ago, and the ∩ rail track west of Harper's Ferry has cost, for the three years of its duration, about $190 per mile. The maintenance of the H rail track of the Washington branch has, in nine years experience, cost about $275 per mile per annum. The saving of the edge, compared with the plate rail, would then, for the first year, be $32,200, instead of $7268, and for the second year, $44,344, instead of $19,136, as just stated.

From the preceding comparison, founded, it is firmly believed, upon the safest and most satisfactory data, furnished by the ample experience of our own road, and substantiated by that of other works, we are authorized to draw the conclusion that, if at this date, we had a new edge rail track instead of the old plate rail track east of Harper's Ferry, we should have saved not less than $32,000, during the past year, in the cost of its maintenance, under the estimated trade of this year.

Again, the following table extracted from the same report, will shew the probable reductions in the cost of working the road between Baltimore and Harper's Ferry, due to the substitution of an edge rail for the present plate rail between those points:

Tabular Exhibit of the Probable Reductions in the Cost of Working the Road between Baltimore and Harper's Ferry, due to the Substitution of an Edge Rail for the present Plate Rail Track between those points.

DESCRIPTION OF TRACK.	Seven years preceding Oct. 1, 1845.					Year ending October 1, 1846.					Year ending October 1, 1847.				
	Trade of 63,632 tons.					Trade of 157,731 tons.					Trade of 205,109 tons.				
	Repairs and Renewals of Track, including interest	Repairs and Renewals of Machinery.	Motive power Expenses.	Interest on Capital invested in Burthen Cars.	TOTALS.	Repairs and Renewals of Track, including interest	Repairs and Renewals of Machinery.	Motive Power Expenses.	Interest on Capital invested in Burthen Cars.	TOTALS.	Repairs and Renewals of Track, including interest	Repairs and Renewals of Machinery.	Motive Power Expenses.	Interest on Capital invested in Burthen Cars.	TOTALS.
Plate Rail,	$79,396	$49,099	$54,239	$1,620	$184,354	$113,068	$85,922	$68,372	$7,680	$375,042	$129,812	$103,596	$85,371	$10,800	$339,579
Edge Rail,	84.824	42,030	40,680	1,350	168,884	94,760	73,553	51,274	6,384	225,971	99,636	88,682	64,028	9,000	261,346
Differences, all against Plate rail but the 1st, marked (a.)	a 5,428	7,069	13,559	270	15,470	8,308	12,369	17,098	1,296	49,071	30,176	14,914	21,343	800	68,233

From the summary of the savings under the four heads of expenditure, above considered, it is seen that, with an edge rail, the Company would have saved in the operation of the last seven years, the sum of $15,470; and that with such a rail, they would have saved in the working of the road during the past year, $49,071; and, in that of the year following, $68,233, *after allowing six per cent interest on the cost of the new track.* And if interest at the rate of $120 per mile be allowed upon the sunken capital of the old track, if it were now abandoned, the saving would then have been for the present year, $38,031; and for the next, $57,193, *clear of all drawbacks whatever.*

And if we look no further in estimating the repairs of the new track than two years ahead, the saving would be $62,963 for the first, and $82,401 for the second year.

This, then, is the result of the balance of "advantages and disadvantages," so far as they are susceptible of being estimated in money, upon principles and data which are demonstrably true. Under these circumstances the board, being deeply impressed with the necessity that the road should be repaired in the most substantial manner, on the 5th of January last, in conformity with the report of the Committee of Finance, passed the following resolution:

"*Resolved*, That it is expedient that all contracts necessary to the immediate re-construction of thirty miles of the road be made without delay."

In conformity with this resolution contracts were entered into with the New York and Maryland Mining Company, and the Covington Manufacturing Company, for a supply of iron, and the whole line of the road to the extent of thirty miles was put immediately under reconstruction.

About one-fourth of this distance has been completed, and it is confidently expected that the remainder will be ready for use before the 1st of January next.

In entering upon a work requiring so large an expenditure, the Board of Directors calculated upon raising the necessary means by a sale of the Company's bonds to the extent of one million of dollars—and they accordingly authorized bonds to be issued to that extent. Efforts were made both in this country and Europe to that effect, but so far without much success. It is hoped, however, that the measures which have recently been adopted by the board will have the effect of placing the bonds upon very high ground as an investment, and of insuring for them a ready sale in the course of the coming year.

The number of passengers carried over the Washington road during the year was 157,156, showing an increase over the year previous of 53,568, and the statement of the revenue shows an increase of $21,851·50 for the same period.

It is true that a large portion of this increase is due to the great number of passengers which passed over the road during the continuance of the national fair held at Washington city in the month of May last—but a comparison of the receipts from the road independently of this consideration, since the period of the reduction of fare in the month of September, 1845, will show a manifest and decided increase over the corresponding period when the high rates were charged, and the competition with the stages existed.

The condition of the tracks upon this road is entirely satisfactory—the cost for repairs is comparatively light, and the trains proceed without embarrassment, and with but little interruption.

During the last winter the citizens both of Virginia and Pennsylvania, feeling a deep interest in the extension of the road to the Ohio river through these States, made earnest appeals to their respective legislatures for the right of way.

In Virginia the effort resulted in nothing more than some slight modifications of the law passed at the previous session, but retaining the most objectionable features in full force.

In Pennsylvania a law was passed authorizing the Company to pass through that State, which is exceedingly embarrassing in many of its provisions, and moreover is made to be dependent for its vitality upon the failure on the part of the citizens of Philadelphia to subscribe the sum of 3,000,000 of dollars to a Company incorporated at the same session to construct a road from that city to Pittsburg. To what extent that subscription has been made I am not informed, but even if it should fail to the extent required, it is not believed that the law could be accepted by this Company.

Authority, however, was conferred upon the Pittsburg and Connellsville Railroad Company to extend their work to the Pennsylvania line upon any of the waters of the Youghiogeny river, and it is understood that that Company is about to prosecute its work with a good degree of energy. Should it succeed in accomplishing its object to the point designated, the distance between its terminus and that of the Baltimore and Ohio Railroad at Cumberland, will be so short, as to render the connexion between the two works entirely practicable.

When this is accomplished, a continuous line of railroad between Baltimore and Pittsburg will be established, throwing open the fertile districts of Pennsylvania through which it will pass, and bringing the counties bordering even upon the great lakes to pour their tribute of commerce and wealth into the lap of *our own city*.

I remain, very respectfully,
Your obedient servant,
SAMUEL JONES, JR.

Baltimore, Oct. 7th, 1846.

Comparative Summary of the operations of the "MAIN STEM" *of the* BALTIMORE AND OHIO RAILROAD,—

from 1836 *to* 1846, *inclusive.*

Official Years.	FROM PASSENGERS.		FROM TONNAGE.															AGGREGATE of Passengers and Tonnage.
			WESTWARDLY.				EASTWARDLY.						TOTAL.				Amount from Tonnage.	
	Passeng'rs	Amount.	Tons.	h.	qr.	lb.	Bls. Flour.	T's Coal.	Tons.	h.	qr	lb	Tons.	h.	qr.	lb.		
1836	157,102	$128,126·30	25,898	5	1	0	172,664		40,805	3	3	1	66,703	9	0	1	$153,186·23	$281,312·53
1837	140,699	145,625·29	33,901	5	3	10	113,870		40,696	4	3	5	74,597	10	2	15	155,676·09	301,301·38
1838	150,516½	166,693·53	30,079	11	1	3	142,512		47,447	7	3	24	77,526	19	1	2	198,530·79	365,224·32
1839	152,501	173,860·44	45,878	4	3	10	264,033		54,573	7	1	4	100,451	12	0	14	233,487·06	407,347·50
1840	152,418	177,035·75	25,638	10	0	9	392,449		62,736	3	1	24	88,374	13	2	8	255,847·95	432,883·70
1841	171,629½	179,615·80	23,442	13	0	19	255,818		42,056	4	3	0	65,498	17	3	19	211,454·07	391,069·87
1842	154,568	181,177·35	30,243	15	3	9	233,539		37,600	14	0	19	67,844	10	0	3	245,315·31	426,492·66
1843	149,533	274,617·27	27,191	16	3	3	266,146	4,964	55,523	11	2	20	82,715	8	1	23	300,617·81	575,235·08
1844	173,821	336,876·32	33,224	16	1	2	241,550	5,433	69,886	11	1	23	103,111	7	3	0	321,743·66	658,619·98
1845	202,458½	369,882·30	50,541	16	2	23	235,602	16,020	90,865	3	3	20	141,407	0	2	18	368,720·88	738,603·18
1846	280,264½	413,341·59	83,559	2	3	9	412,776	18,393	110,356	18	0	22	193,916	1	0	6	468,315·94	881,687·53
Totals,	1,885,511	$2,546,851·94	409,599	18	3	22	2,730,959	44,810	652,547	11	2	12	1,062,147	10	2	9	$2,912,925·79	$5,459,777·73

(A)

The Baltimore and Ohio Railroad Company.

Dr.		Cr.		
Stock in the Washington Branch Road,	$1,032,600·00	Loan at six per cent.,		$1,000,000·00
Cost of road to Harper's Ferry, including real estate and depots, locomotives, passenger and burden cars, &c., &c.,	4,000,000·00	Loan No. 2, at six per cent.,		6,984 00
Cost of road west of Harper's Ferry,	3,623,606·28	Stock,		7,000,000·00
Coal trade, for amount due on that account,	101,494·78	Baring, Brothers & Co., London, for Balance now due,		103,708·95
Sterling bonds in the hands of Messrs. Baring, Brothers & Co., of London,	3,181,005·11	State of Maryland five per cent. sterling bonds,		3,200,000·00
City of Baltimore six per cent. stock on hand,	20,096·59	Forfeited stock, for balance of that account,		183·45
Sinking fund for the redemption of the million loan,	55,990·00	Interest received on city stock,		1,170·65
Invalid fund for amount due by that account,	196·28	Revenue for balance of this account on the 1st Oct., 1845,	$581,767·21	
New York and Maryland Iron and Coal Co., due by them,	13,627·59	Amount which has accrued since,	895,315·22	
Stock in the Pittsburg and Connellsville Railroad Company, for instalment paid,	1,750·00	Dividend from Washington road in April last,	25,815·00	
Cash in the hands of officers,	15,094·63		1,502,897·43	
Cash on hand,	58,868·71	Less expenses, repairs, and interest, including the sum of $206,312·06 expended for re-construction, locomotives, improvement at depots, and various purposes on account of construction,	710,614·41	
				792,283·02
	$12,104,330·07			$12,104,330·07

(B.)

Statement of the Revenue and Expenses of the Baltimore and Ohio Railroad Company, on account of the Main Stem of the road for the year ending the 30th September, 1846.

The amount received for the transportation of Passengers, Mails, and Merchandize, for the year ending the 30th September, 1846, has been		$838,375·39
And the amount from the Coal Trade, inclusive of a debt of $13,627·69 due by the New York and Maryland Iron and Coal Company, is . . .		56,939·83
Making an aggregate of . .		895,315·22
And the Expenses for the same period, have been the following, viz:—		
Expenses of Transportation, including Fuel, Salaries of the Superintendent, Agents, Conductors, &c.,	$146,057·91	
Repairs of the Road, . .	116,163·49	
Repairs of Locomotives, . .	56,051·17	
Repairs of Passenger Cars, . .	18,682·48	
Repairs of Burden Cars, .	29,950·66	
Repairs of Bridges, . .	58,139·73	
Repairs of Depots, . .	10,742·71	
Repairs of Water Stations, . .	2,119·76	
Watching Bridges and Pumping water at Water Stations, . . .	9,575·81	
Office and Incidental Expenses, including Salaries, House Rent, Fees to Counsel, &c., &c.,	7,356·16	
Making an aggregate of Expenses of .		454,839·88
And shewing the net earnings of the road to be		$440,475·34

EXTRACT FROM TABLE C.

Receipts and Expenses.

Received for the Conveyance of Passengers,		$333,447·51
“ “ Transportation of Tonnage,		446,266·00
“ “ “ U. S. Mail,		43,210·00
“ “ Use of Main Stem to Relay House by Passengers Washington Branch,		35,132·85
“ “ Use of Main Stem to Relay House, Tonnage,		18,289·18
“ “ Tolls upon Harper's Ferry Viaduct,		1,551·23
“ “ Use of Cars on Winchester and Potomac Railroad,		3,790·76
		881,687·53
To which add amount of debt due by Maryland and New York Iron and Coal Company,		13,627·69
And we have amount of Revenue as shown by Secretary's Statement B,		895,315·22
Expended for Conveyance of Passengers and Mails,	$109,954·82	
“ “ Transportation of Tonnage,	319,145·46	
		429,100·28
Showing the net Revenue to have been		466,214·94
To which, in order to shew the same results as exhibited by Statement B, in the 20th Annual Report of the Baltimore and Ohio Railroad Company:		
Add cost of Repairs of Coal Cars, which item is included under the head of “*Coal Trade*,” in the Secretary's statement,		2,530·93
And amount of decrease in value of Materials on hand for Repairs of Bridges and Passenger Cars,		714·54
		469,460·41
And deduct for permanent improvements to Bridges,	$23,381·56	
“ “ “ “ Locomotives and Tenders,	4,365.03	
“ “ increased value of Materials on hand for Repairs of Railway and Burden Cars,	1,238·48	
		28,985·07
Surplus same as shown by statement B, above referred to		$440,475·34

Remarks.—Besides the tonnage transported as above, and for which the Company have received pay, there have been hauled of materials for repairs of railway and bridges, and of fuel for locomotives, &c., equivalent to 1,649,704 tons one mile; which amount, if added to the 14,614,986 tons hauled one mile by locomotives, as above stated, and their sum divided by the number of miles run by locomotives with tonnage trains, will show the average net load of each engine to have been 31½ tons, which is 2·3 tons greater than the average of the previous year.

There have been carried over the Winchester and Potomac Railroad, in the cars of this Company, equivalent to 596,947 tons one mile.

The average number of passengers in each train has been 69.

“ “ charge for the transportation of tonnage, 3·021 cents per mile.

“ “ charge for the conveyance of passengers, 3·116.

“ “ cost for repairs and renewals of locomotives, 7·753 cents per mile, run with trains.

The average charge for transportation, exclusive of coal, 3·419 cents per mile, run with trains.

The average cost of running the trains, exclusive of horse power in the streets of Baltimore, has been 59·8 cents per mile.

The average cost of running the trains, inclusive of horse power in the streets of Baltimore, has been 64·4 cents per mile.

The expenditures common to both passenger and burden traffic, have been divided in proportion to the number of miles run by locomotives, with the trains of each description; the greater speed of the passenger trains being considered as fully, if not more than, equivalent, to the somewhat greater average weight of the tonnage trains.

James Murray,
Engineer of Machinery and Repairs.

(Tables D, E, F, omitted.)

The Gauge Commission.

Analysis of Evidence given before the Royal Commissioners appointed to investigate the subject of the diversity of Railway gauges.

Continued from Page 14.

Mr. Edward Bury: Is a manufacturer of locomotive engines, and has been such for 17 years. The heaviest engine made by witness has not exceeded 13 tons. 14-inch cylinder the largest yet made by witness; evaporating surface in proportion to the cylinder. Length of boiler increased from 8 feet 6 inches to 11 feet 6 inches. Space between fore and hind axle very considerably increased; interval 7 feet 6 inches. Witness considers the speed now attained on narrow gauge lines as great as is consistent with safety. The securities for the rails not sufficient to justify a higher rate of speed.

The transverse sleeper better than the longitudinal. There is a better chance of keeping the transverse right than the longitudinal sleeper; there is a great deal less packing with the transverse sleeper than the longitudinal sleeper; the under surface of the longitudinal sleeper is too great to admit of its being thoroughly and uniformly packed. Greater speed can be obtained on broad gauge than on narrow, because the speed depends upon the ratio of the stroke to the wheel, and on broad gauge a longer stroke and larger wheel can be had. The narrow gauge trains, however, can travel faster than is necessary or safe. If the Midland Counties were changed to broad gauge, the inconvenience to the London and Birmingham Company would be so great that they would be compelled also to change to broad gauge. Does not consider the rigidity of the rail essential to safety at high velocities; it would be better with a moderate elasticity in it. The best part of the Liverpool and Manchester Railway, and the most easily maintained, is that which occurs at Chat Moss, which is always elastic. The most difficult part to maintain on the Liverpool and Manchester line was that which went through Olive Mount, which is on a stone foundation. They have been obliged to take the stone out for a considerable depth under the rails and fill it up with ballast. The engineer of the Bolton and Manchester line was anxious to make that line perfectly rigid. He built a continuous wall, and put upon it a T rail; but that did not stand at all; it knocked everything to pieces; it was always out of order, and they have been obliged to change it. The rail itself ought to be rigid, and the foundation on which it is placed should be elastic. Does not think any of the rails that have hitherto been laid are heavy enough. Has no knowledge of the feeling of proprietors in the mineral districts with respect to broad or narrow gauge, but considers that the narrow gauge is more suitable to their traffic, because the curves can be made sharper than on broad gauge, and bring them closer to the pit's mouth. Prefers a wider gauge than 4 feet 8½ inches, which witness believes too narrow for the engines and carriages and machinery working on the rails. 6 or 8 inches' additional width would be amply sufficient. Does not at present use outside cylinders, but some are now being made. Can get sufficient power on the narrow gauge, but a more convenient and accessible machine, with greater range and capability, could be constructed with a little additional width of rail. If witness had to determine on the gauge for a country having no railway, should certainly not adopt the 4 feet 8½ inch gauge. Would not adopt the 7 feet gauge. Should adopt an intermediate gauge, as preferable for engines, carriages, and wagons. Strength of passenger carriages on London and Birmingham Railway considerably increased, weighing 10 or 12 cwt. more than when the line was first opened; this increased strength essential to public safety as well as to the durability of the carriage. Reserve fund appropriated to purchase of new engines. Stock deteriorated within the last half year in consequence of being compelled to run the engines, &c., longer without the usual repairs, on account of the heavy traffic on the line.

Stock of Great Western Company valued at £534,000; of the London and Birmingham at £275,000, the latter doing the most work; difference accounted for by inferior size and expense of engines on London and Birmingham line. With the additional stock the expenses will come nearer the expenses of the Great Western Company. The 175 miles now worked with the original stock of the line. They have 93 engines and one borrowed from another Company.

Accidents from breaking of axles of rare occurrence; not one carriage axle broken within the last five years, and very few engine axles. The fracture of axle usually occurs in the journal; outside the wheel in the carriages, and inside the wheel in the engines. Engines frequently run some distance with a broken axle; have never had one so crippled as to be unable to get home; some have even taken out trains with a broken axle. The train taken off the line from broken axle in only one instance, when the front axle of the engine broke. Increased length of engine gives increased steadiness. Messrs. Sharp are manufacturing an engine with 18-inch cylinders; the cylinders are not placed outside the wheels, but inside, so that there is room for two 18-inch cylinders with the narrow gauge to be constructed inside the wheel, with the crank shaft. Impossible to say what load an engine can be made to take on narrow gauge, but considers that for the ordinary traffic of the country, an engine on narrow gauge may be made of sufficient power to take at high speed both passenger and luggage trains. Present luggage engine on London and Birmingham line too small. Luggage trains often worked with several engines. The heaviest luggage train on this line was a train of 112 or 116 wagons, making upwards of 600 tons; for this train four engines were used.

Long trains much impeded by high winds. Has seen the transverse sleepers pushed out of their places, sometimes twisted like the letter S, by the expansion of the rail; this has occurred when sufficient allowance was not made between the rails for expansion. Average speed of express trains on London and Birmingham line 43½ miles an hour, including stoppages. They now use 13-inch cylinders; some of their engines for the express trains have been altered, by increasing the size of the boilers, an additional inch to the cylinders, and three inches to the wheel. Does not think it safe to run a small train very fast; should prefer more weight on the engine to make it run steadier; when any of the royal family are on the line, always put more carriages on than are required for passengers, in order to steady the train. Has frequently traveled by express train on London and Birmingham; there is very little oscillation; thinks the express train steadier than any other because it is better screwed up; everything is in higher order. Outside cylinders not yet tried on this line; they were tried on the Liverpool and Manchester and condemned; the oscillatory motion objected to; the boilers, however, were shorter than they are at present; there was a greater tendency to the yawing motion. Decidedly objects to the use of carriages with shifting wheels on account of the difficulty of keeping the securities always right. Experiments have been made in the United States to allow wheels to adjust themselves on curves; they were soon abandoned, it being impossible to keep them in order. A very small increase on the narrow gauge would afford great accommodation in the construction of the engine. The difficulty of oiling and cleaning the narrow gauge engines a very great inconvenience, and can only be felt by engine makers. They require more space for the tube of boiler, and a larger fire-box.

Mr. Benjamin Cubitt: Does not think an equal power can be obtained on narrow as on broad gauge. The narrow gauge does not allow width enough to get a fire-box large enough, and is cramped for width in getting strength for the working parts of the engine. Thinks it impossible to make so effective a boiler for narrow as can be made for broad gauge.

Has not particularly considered the relative advantages and disadvantages of outside or inside cylinders. There are about half-a-dozen outside cylinders upon the lines of which witness is superintendent. Total stock of engines about 120; all but 16 on 6 wheels. The Dover Company have ordered a large number of outside cylinders. Has ridden a good deal upon the outside cylinder engines. At first they travel as steadily as the inside cylinders, till they have been at work eight or ten weeks, and then they begin to get side play and oscillate a good deal. This motion increases with the wear. The repairs upon outside cylinder engines are not more costly than upon inside cylinder engines.

The repairs required on the outside cylinder engines.

No. of Engine.	Maker.	Description.	Continued Working.	Miles Run.	Coke used.		Cost of Repairs.	Heating surface	
					Total.	p mile		fire-box	Tubes.
					Cwt.	lbs.	£. s. d.	sq. feet.	sq. feet.
42*	Sharp and Co.	Crank axle with outside bearings.	Feb., 1844, to April 12, 1845.	40,135	11,304	31·54	137 8 8	60	476
43†	Bury and Co.	Crank axle with inside bearings.	Aug., 1844, to April 12, 1845.	14,626	5,580	35·07	109 7 10	59	595
44‡	Stephenson.	Straight axle, with outside cylinders and inside bearings.	Oct., 1844, to April 12, 1845.	18,447	4,867	29·55	67 14 1	55	898
Bodmer Engine								73	769

*April 14, 1845.—Taken into dock to have new tyres, axle-bearings, and general repairs.

† August, 1844.—Taken into dock for two new eccentric straps, and temporary repairs.

‡ April 21, 1845.—Taken into dock for new driving-wheels, new bearings in leading wheels, and general repairs.—July 10, 1845:—Taken into dock for new bearings to trailing wheels.—July 22, 1845:—Taken into dock for leading wheels keyed on to axles, and new axle boxes and bearings to driving-wheels.

In the narrow gauge inside cylinder engine there is scarcely sufficient space for the necessary repairs and cleaning; there is also a difficulty in the outside cylinder to get at the bearings, both to oil and to clean them, without lifting the engine. As a locomotive engine-maker, is in favor of a gauge of 5 feet 3 inches. There is at the New Cross station a new engine of great power made by Bodmer; he has taken out a patent not only for locomotives, but for steam engines in general, for what he calls a compensating engine, as it works with two pistons in one cylinder, so that the connecting rods pull and thrust at the same time, which takes the strain off all the other parts of the engine, except between the cylinder and the crank. The length of the boiler is 10 feet, the cylindrical part of the boiler. The fire-box is as large as it can be got to suit the gauge. This engine has been tested against other engines and found more powerful than any other with one pair of driving wheels, because it is a larger engine, with a larger boiler, and larger cylinder; the cylinders are 16 inches in diameter, and the stroke is equal to a 30-inch stroke, being four 7½-inch cranks. It has taken 38 carriages upon an incline of 16 feet a mile, about 4½ miles long, at about 20 miles an hour, with a gross load of about 150 tons.

Cannot accurately ascertain the comparative locomotive cost of working goods trains and passenger trains upon this line, the accounts not being separately kept.

Locomotive Expenses of the Brighton, Croydon, and Dover Railways, compared with the Great Western Railway Company, for the half-year ending December, 1844.

—	Great Western Railway Company.		Brighton, Croydon, and Dover Locomotive Co.	
	Passengers.	Goods.	Passengers.	Goods.
Number of engines and tenders belonging to the Co's.	102	22	83	14
Number at work during the half-year,	96	22	77	14
Number of engines in steam each day,	35	11	25	7
Average number of miles run during the half-year,	7590	8720	6555	5252
			Passengers and Goods.	
Average cost per ton per mile,	0·15d.	0·05d.	0·182d.	
Average weight of coke per ton per mile,	lb. 0·56	lb. 0·23	lb. 0·587	
Average quantity of coke used per mile run,	34·27	51·99	34·93	
Average cost of repairs, including general charges per mile,	2·81d.	2·51d.	3·31d.	
Average cost of coke per mile run,	3·88	5·86	4·87	
Average cost of wages per mile run,	1·39	1·44	1·49	
Total cost per mile run,	9·90	12·07	11·12	

Dimensions of two engines on Brighton, Croydon, and Dover Railway.

	Diameter.		Length.		Depth.		Breadth.	
Stephenson's Engine, Six Wheels.								
Passenger Engine, Link motion:	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Cylindrical part of boiler.	3	0	12	6				
Outside fire-box,			3	8	7	8	3	8
Inside fire-box,			3	0	4	1½	3	0
Smoke box,			3	0			3	8½
Tubes, 150,	0	1¾	13	0¼				
Chimney,	1	2						
Cylinders, 1 foot 10 in. stroke,	1	3						
Driving wheels,	5	6						
Sharp's Engine, Six Wheels.								
Passenger Engine:								
Cylindrical part of boiler,	3	6	8	0				
Outside fire-box,			3	8	7	10½	4	2
Inside fire-box,			3	0	4	0	3	7
Smoke box,			2	1½			4	3
Tubes, 98,	0	2	8	5				
Chimney,	1	1½						
Cylinders, 1ft 6 in. st'ke	1	2						
Driving wheels,	5	6						

Distance from Centre to Centre of leading and following Axles.

Stephenson	44	Six wheeled, Passenger Engine	10 feet 3¾ in.
Sharp,	8	Ditto, ditto	11 3½
Bury,	23	Four wheeled, ditto	7 2
Bury,	39	Ditto, coupled	7 8

The passengers of an ordinary train of 10 or 12 carriages could not be changed from one train to the other under 20 minutes. With engines on narrow gauge, even with outside cylinders, there is more difficulty in getting access to the axles to clean and oil them than in the broad gauge. This difficulty of oiling the axle depends upon the circumstance of the cylinders being outside, and not upon the breadth of the gauge. It is easier to do this with the wide gauge engines; on the crank axles the bearing is taken on the outside of the wheels; on the four-wheeled engines the bearings are inside bearings, and there is a difficulty in getting the men to keep those bearings clean. If the gauge were increased from 4 ft. 8½ to 5 ft. 3, the weight of the engines would be increased from 15 cwt. to a ton. Average weight of engines on South Eastern Railway, about 14 tons; on Great Western about 17 tons. Considers that the general construction of the roads will admit of heavier engines being placed upon them.

Weight of rail upon the South Eastern line 85 lbs. a yard. The bearings average 3 feet apart upon a cross sleeper. The sleepers are triangular, they are four triangles cut out of a 13-inch square. The rails are fastened to chairs with wooden keys; and the chairs are fastened to the sleepers by wooden treenails. The boilers on the Great Western are not much larger than those upon the Brighton line. If witness had the control of the engines of the Great Western, should certainly make larger boilers. There is room to get sufficient strength and cranks, with inside cylinders; but the engine and the boiler have to be raised, which is a great objection. Would like to have the cranks more separated, and keep the boiler still the same height. To give the cranks strength, obliged to make the bearings shorter to get room for the cranks. The thickness of the side of the crank, which is perpendicular to the axis, 4 inches; some 4¼. Does not think it necessary to make that thicker; the great advantage would be in getting the bearings longer. The eccentrics are reduced as much as possible. When they are very short bearings, they are apt to heat and get dry; then they cut away the journal, and it is reduced and made weaker. With the present construction of the South Eastern Railway, should venture to increase the speed by having much more powerful engines. The quickest train is upon the Brighton line, which runs from Brighton to London in an hour and a half; that is 50½ miles, stopping once five minutes. The distance is often run in an hour and a quarter; some parts of the distance cannot be run at 40 miles an hour, on account of the gradients; and other parts have to be run at more than that speed, in order to keep the time. There are 120 engines for the three Companies, working 166 miles. This includes the Dover, Brighton, and Croydon, and two miles of branch to the Bricklayers' Arms, and the branch to Maidstone.

William Cubitt, Esq.: The limit to safe speed on narrow gauge lines is the want of evaporating surface and space for the fire-boxes, the want of solidity and perfection in the road, the want of base for engines or carriages, the want of greater strength in the rails, and greater security in connecting them with sleepers; many accidents have been caused by attempting to go too fast upon a bad road. And that danger is very much increased by increased velocity. A speed of 15 or 20 miles an hour may be safely attempted on a bad road, while double that speed would throw engines and carriages off the line of road. Attention to the state of the road has not kept pace with the improvement in the driving machine. Before increased speed is attempted that particular should be attended to. The perfection of the permanent way has been less thought about than almost any other part of railway mechanism, and that is the basis upon which it all rests. Does not think that the speed might be increased, without a corresponding increase of danger to the traveler, by adding to the width of the narrow gauge; considers the narrow gauge wide enough for safety at almost any practicable speed, but not wide enough to get the most perfect machinery for speed. An addition of 6 or 8 inches over the present narrow gauge is wide enough, perhaps, for all practical purposes of machinery of locomotive engines and carriages. A gauge of about 6 feet would be the best. Has often heard that an increase of gauge would involve the necessity for widening the tunnels; does not concur in this opinion; if the size of the largest loads is not altered, nothing need be altered but the gauge. Does not think that if they had carriages upon a wider gauge, they would wish to carry larger loads; in railway operations would rather adopt the same width, making the vehicles of greater length, which would produce greater safety and greater convenience than by shortening them, so as to produce greater width and greater height. The adoption of a wider gauge in tunnels would not restrict the room for workmen, as regards trains passing; the wheels are always far inside the outside of the trains, and so they would be with the 6 feet gauge, because the loads are 8 feet; the only difference would be that the two inner rails would be nearer to each other, and the two outer rails would be nearer to the walls; the centre of gravity would be the same if the loads were no higher.

An increase of the width of gauge would not render it imperative to have a corresponding increase of the radius of the curves. An increase of the gauge would not render necessary a corresponding increase of the height of the driving wheel. Does not think that, in reference to the number of miles run on the broad gauge, and the number of miles run on the narrow gauge, there are fewer accidents on the broad gauge than on the narrow. The superiority of either gauge depends not upon the gauge, but upon the condition of the permanent way. Gradients are of less importance if the road is in perfect order. Rigidity in a road is preferable to elasticity in a road. With elastic rails, it becomes like driving over a series of points. If there be any elasticity at all, it is best to have it in the whole road, like having a perfect road laid upon a bog, as in Chat Moss or any other soft ground, where the whole railway itself could, in a very great length, have a very slight elasticity. There is less cost in the repair of Chat Moss than any other part of the Manchester and Liverpool Railway, on that account. It always will be so upon soft ground. If you have a good permanent way, thick enough and strong enough in itself, and lying upon a substratum, which has a little tendency to elasticity, it is most easily kept in repair. Cross-sleepers are better than longitudinal sleepers for keeping in repair. Any sleeper of a proper form can be packed, whether it lies longitudinally or transversely. There is a greater length of bearing to be obtained upon cross-sleepers than upon longitudinal sleepers. If we were to have a railway laid from end to end, all upon cross-sleepers, there would be a much greater length of bearings than upon a railway where it is all upon longitudinal bearings; and the greater number of sleepers we have the better the road will be.

Is not aware of the exact limits of contraction and expansion, by cold and heat, of a 16-foot rail; has known the road lifted up; has known it bent sideways by expansion; has never had time or opportunity to measure it exactly; it is a difficult thing to ascertain what the expansion is in certain cases; it can be done best off the line, by ascertaining the temperature of certain lengths of bar uniformly. Expansion and contraction on longitudinal bearings have a tendency to loosen the screws which bind the rail to the balk.

Break of gauge is of little consequence in reference to passengers, but becomes a great difficulty in transferring heavy goods. It becomes a matter of importance to devise the best, cheapest, and quickest mode of transhipment from one gauge to the other, whether it be by removing the goods from one carriage to another carriage, or by moving the body of one carriage on to another set of wheels by mechanical power; it becomes a question of cost. The measure of the inconvenience is the cost per ton to do it quickly. The expense of constructing powerful lifting machines of little importance where the traffic is large; has laid out £130,000 to save about a halfpenny per ton upon the shipping of coals. Could put up apparatus to move 25 wagons in one minute, or in a couple of minutes, requiring the employment of not less than 50, nor more than 100 men. The cost of transhipment would be a trifle upon a long line, but a large item upon a short one. It is perfectly easy to make wagon frames and wagon bodies for a large trade that would go to any part of the country; the bodies must go quite through, and return again; the frames would keep on their own lines, and the wagons would simply drop into them. There would be no difficulty in constructing passenger carriages to move in the same way; if there is traffic enough to render it worth doing, there is no difficulty in doing it. Civ. Eng. & Arch. Jour.

(To be continued.)

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Note on the Measurement of Water delivered through large (or wide) Orifices. By M. MORIN.

I propose communicating, successively, to the Academy, the results of the experiments made by me in 1844 and 1845, at the powder mill of Bouchet, on various hydraulic motive powers; either by order of the Minister of War and with reference to the powder department, or for the purpose of examining questions submitted to the decision of the Academy itself.

In experiments on hydraulic motive powers, the most delicate portion, and that most subject to error, is the measurement of the quantity of water expended. Local circumstances, forms, or shapes, the arrangement of flood-gates, exert on that quantity great influence, which, as yet, has been too little studied, and the inexact appreciation of which has frequently led the most conscientious observers into serious errors, to which may be attributed, very frequently, the manifest exaggeration of certain results announced with the most perfect sincerity.

In order to place myself out of the reach, as far as it depended on me, of such errors, and to establish with some certainty, or at least with a sufficient approximation to it, the ratio of useful effect produced by the motive powers submitted to experiment, to the absolute amount of water expended, I endeavored to determine upon a mode of measurement beyond the reach of controversy, which was somewhat difficult.

For this purpose, I first reflected whether I could measure, with sufficient exactness, the quantity of water supplied by an overshot-wheel flood-gate fixed at the head of a canal, or race, in which the motive powers to be subjected to experiment were to be placed.

This flood-gate is equal in width to the head-race, which is constructed of masonry; it is inclined from above downwards at an angle of about 65 degrees to the horizon; its upper edge has an acute angle up-stream, and is rounded off down-stream; it is 0·08 m. thick. Two racks, each of 0·05 m. wide, reduce the clear width to 2·017 m.

In order to estimate the volume or quantity of water that passed over this flood-gate, the tail-race, which was constructed of masonry, with a rectangular section, was closed below by a vertical dam of plank, in which were made three openings; to these were fitted wicket-gates of about 0·300 m.* square, of thin sheet iron, of about 0·005 m. in thickness, sliding in front of the orifices, which were formed with sharp edges, similar to those made use of in the experiments of Messrs. Poncelet and Lesbros. These small sheet iron wicket-gates were, by means of screws, worked by hand; rods, with marks showing the level, were placed in front of the overshot-wheel flood-gate and the wicket-gates, in order to show and to verify the invariableness of the levels.

From this short description, it may be readily conceived, that by making simultaneous observations at the overshot-wheel flood-gate, and at the orifices with thin sides, the supply, or quantity delivered, by the two kinds of orifices might be calculated, by means of the very precise results of the experiments of Messrs. Poncelet and Lesbros, and which were evidently applicable, with all desirable exactness, to the case in question.

But these experiments, undertaken on canals of great dimensions, which had vast basins, subject to the effects of the winds, and whose level it was difficult to regulate perfectly by means of an ordinary mill flood-gate, could not possess a degree of exactness comparable to that of experiments made under more favorable circumstances. In order to examine into the whole together, and to disengage the results from accidental influences, we have re-produced them by a graphic construction, taking the values of the *charge*† H, on top of the flood-gate, as abscissa, and those of the coefficient of the supply or delivery as ordinates.

In examining the table of the results, and, above all, the curve which represents them, it is seen that the values of the coefficient of the supply or delivery increase rapidly with those of the *charge* H, on the ground-sill of the orifice, from $H = 0·03$ m. and 0·04 m. up to H 0·10 m., a term beyond which they still continue to increase, but more and more slowly.

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* The *metre*, which is the measure adopted in this paper, is equal to 39·371 English inches.

† The word *charge* throughout this paper, is intended to designate the depth of water on top of the flood-gate.

If, to compare these results obtained with a flood-gate of 2·017 m. in width, equal to that of the head-race, and placed in the before-mentioned circumstances, with those which relate to a flood-gate of 0·20 m. wide, to complete contraction, we determine, by means of the figure, the values corresponding with the *charges* observed, in this last case, the following table may be formed, which we limit to the charges with which we have operated :

Width of Orifices.	Values of the coefficient m, of the formula $Q = m L H \sqrt{2gH}$, For the values of H equal to					
	0·04 m.	0·06 m.	0·08 m.	0·10 m.	0·15 m.	0·20 m.
0·200 m.	0·407	0·401	0·397	0·395	0·393	0·390
2·017	0·264	0·355	0·418	0·448	0·469	0·482

It is seen that for small *charges,* this flood-gate, of 0·08 m. thick, produces a notable diminution in the supply or delivery, although the contraction may be nearly annulled on the vertical sides of the orifice. This effect is analogous to that observed by Messrs. Poncelet and Lesbros on small overfalls passing through a shute. We know, in fact, that, in the cases in which the contraction is nearly null on the sides, these observers found the following values of m :

Charges on the upper side of the overfall.	0·04 m.	0.06 m.	0·10 m.	0·15 m.	0·21 m.
Values of m.	0·246	0·271	0·308	"	0·324

These values, which, for small *charges,* make a very near approach to those we have obtained, show that the diminution of the supply or delivery depends, in both cases, on the same cause, on the resistance of the side or wall of the flood-gate, or of the shute. We notice, in fact, that in small *charges,* the fluid vein wets and follows the surface of the flood-gate ; but in proportion to the increase of the *charge,* this influence of the sides or walls diminishes, and soon, indeed, the fluid vein detaches itself completely from the upper edge, which is sharp up-stream, and the resistance of the surface of the flood-gate ceases to be felt, whilst at the same time the suppression of the lateral contraction continues to exert an increasing influence on the augmentation of the supply or quantity delivered ; whence it results that the coefficient of the supply or delivery increases.

Such is the natural and simple explanation that may be given of the smallness of the values of the coefficient of the supply or delivery for the small *charges,* and of their magnitude for the large *charges* observed in our experiments.

Notwithstanding the care taken in the execution of these experiments, the local causes and circumstances mentioned did not permit us to approximate nearer than $\frac{1}{18}$th or $\frac{1}{20}$th ; but the sketch shows, nevertheless, by taking them as a whole, the gradual and continual progress of the increase of the coefficient of the supply or delivery, and, until new and more precise researches are made, I think we may, in applications to analogous cases, adopt with sufficient accuracy for practice, the values deduced from the sketch, for the coefficient of the supply or delivery, viz :—

Charges on the Sill of the Overfall,—in metres.

0·04, 0·05, 0·06, 0·07, 0·08, 0·09, 0·10, 0·12, 0·14, 0·16, 0·18, 0·20.

Values of the Coefficient m.,—in metres.

0·264, 0·313, 0·335, 0·390, 0·418, 0·437, 0·448, 0·460, 0·467, 0·472, 0·477, 0·482.

These values, which, for *charges* exceeding 0·10 m., are much greater than those which have been, up to this time, adopted for similar cases, show that flood-gates, arranged like that made use of by us, which is the case with many horizontal wheels, deliver more water than is generally admitted to be the case; and that, in experiments on hydraulic motive powers, we are liable, for want of a good method of measurement, to estimate the supply or delivery of water at one-sixth or one-seventh below the real amount, and, on the other hand, very much to overvalue the useful effect.

It would therefore be desirable that new, special experiments, on large flood-gates, of the proportions most in use, and arranged as is most customary, should be made with proper accuracy. The preparation and arrangement of the necessary apparatus require considerable outlay, convenient localities, and a combination of means and circumstances such as are rarely to be found, and these difficulties make us regret that the experiments already made with so much care and precision, by order of the Minister of War, at Metz, at the expense of the Government, from 1827 to 1834, with a view to the wants of the Artillery and of the Corps of Engineers, should not yet have been published, or even communicated to these corps.

Experiments on an Orifice with the Charge on the Summit.

Although the *ensemble* of the results obtained with the overshot water-wheel flood-gates, enables us to determine with sufficient exactness, at least for practice, the amount of water actually supplied or delivered in the experiments proposed, on hydraulic motive powers, I have thought it best to make use, for this purpose, of an orifice with the *charge* on the summit, so that the height, and, consequently, the area of the orifice remaining the same, the *charge* on the centre, being alone exposed to slight errors of measurement, enters into the calculation of the supply or delivery, but as under a radical of the second degree, and the influence of these errors diminishes when the *charge* increases.

For this purpose, I caused to be made on the same race or canal, an orifice of 1·496 m. in width, the vertical sides of which were 0·16 m.

and 0·165 m. from the sides of walls of the canal, and as the movements or risings of the flood-gate were very slight, when compared with these distances, the contraction might be considered as nearly complete on these sides, as well as on the upper and lower sides.

The determination of the actual supply or delivery by this orifice, was made, as has been before explained, by means of small wicket-gates, whose greatest opening was 0·300 m.

The examination of the results obtained, and above all, their graphic representation, show that the greatest deviations did not amount to more, and were almost always less than $\frac{1}{40}$th of the ordinates of the curve which represents them. And as, for experiments on hydraulic motive powers, such an approximation is quite sufficient, we have been able, in the ulterior calculations of the supply or delivery of water, to adopt the values of the coefficient of the supply or delivery deduced from this very curve.

We wish it to be observed that, in our experiments, the *charges* on the summit of the orifices having been comprised between 0·050 m. and 0·180 m. at farthest, and that this dimension, agreeably to the experiments of Messrs. Poncelet and Lesbros, producing an influence, at most, of only $\frac{1}{72}$, the variation of the coefficients has scarcely depended on any thing except the height of the orifices.

We have therefore been enabled, in accordance with this remark, to seek to compare the values of the coefficient of the supply or delivery which we have found, with those which have been determined for equal heights of orifices of 0·20 m. in width, by Messrs. Poncelet and Lesbros, and we have thus formed the following table :—

Nature of the Orifices.	Values of the coefficient of the theoretical supply or delivery for height of orifices of		
	0·20 m.	0·10 m.	0·05 m.
Orifice of 0·200 m, wide, .	0·592 m.	0·611 m.	0·630 m.
" 1·496 m. " .	0·675 m.	0·679 m.	0·727 m.
Increase owing to the augmentation of width, .	0·083 m.	0·068 m.	0·097 m.
Or .	·100 m.	·100 m.	·100 m.
	8·130	10·000	7·530

It is seen that the width of our orifice appears to have had a considerable influence on the supply or delivery, and that the increase resulting from it for this supply or delivery has varied, in the cases in question, from $\frac{1}{7\cdot5}$ to $\frac{1}{10}$.

These results prove how necessary it was to verify beforehand the exactness of the formula to be made use of for the measurement of the supply or delivery of water, since differences of this kind might result from it.

We will moreover observe that these results, giving amounts of supply or delivery much greater than might have been calculated agreeably to the rules generally admitted, the useful effects obtained from the motive powers studied in the experiments of which we have to give an account, will be diminished in the same proportion, and that, in this point of view, our results will be less favorable to them than if we had been content to follow the ordinary rules.

The experiments on motive powers will be the object of subsequent communications.—*(Academie des Sciences.)*

AMERICAN PATENTS.

List of American Patents which issued in the month of January, 1846,—*with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in the Corn Sheller;* Elijah Converse, Cincinnati, Ohio, January 7.

In this machine, the corn is shelled by the action of radial bars projecting from the surface of a horizontal disk, hung and rotated in manner similar to the runner of a mill, the ears of corn being retained to receive this action by another series of radial bars projecting downwards from the under surface of a dome-formed cap. The ears of corn are fed through an eye in the cap, and pass from thence towards the periphery of the runner, where the cob and grains are discharged. And as the dome shape of the cap gives an inclination to the series of radial bars attached to it, their outer ends are much nearer the face of the runner than their inner ends, which will adapt the machine to ears of all sizes.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the before described manner of constructing the case, that is to say, with a circle of inclined radial bars on the under side of the dome, inclining downward and outward from the eye towards the base of the dome, forming, with the radial bars of the disk, a circle of triangular shaped cells for the reception and shelling of various sized ears of corn, thus doing away with the necessity of having movable concaves and boards, supported by springs to accommodate themselves to the varied sizes of the ears, which springs are liable to get out of order."

2. For an *Improvement in the Machine for Raising Water from Wells;* Jehiel T. Farrand, Port Byron, New York, January 7.

This is for an improvement on the method of raising water from wells by means of a bucket and windlass. The bucket is hung by two ropes, one on each side, which wind around two drums on the windlass shaft, and these ropes are forced and kept out of the perpendicular by a guide-roller, so as to prevent the bucket from swinging, and the ropes from twisting together. And for the purpose of tilting the bucket, to discharge the water, the delivery spout is provided with a hook, on to which the lip of the bucket catches when rising, and by which it is tilted, to discharge its contents into the trough.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the guiding-roller, (for preventing the vibration of the bucket,) in combination with the tilting hook for emptying the bucket, and the double right and left hand ropes for suspending the same, all combined and operating substantially as herein set forth."

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3. For *Improvements in the Stove for Heating Apartments;* James Macgregor, Jr., Wilton, Saratoga county, New York, January 7.

The patentee says,—"I make the aperture for the escape of the products of combustion in the back part of the bottom plate of the fire-chamber, or in any other part of the fire-chamber, not, however, above the door for the admission of fuel and air, so that the products of combustion shall circulate freely within the chamber of combustion, above the fire, to insure the entire combustion of all combustible matter, and then escape into the chimney through the flue space in or near the bottom; there being a passage for air under the bottom plate of the fire-chamber, passing by and communicating with the flue space leading from the fire-chamber, and thence extending to the pipe or chimney; the said air passage being provided with a sliding register, or valve, at the forward part, to regulate the supply of air and draught, and ventilate the room."

Claim.—"What I claim as my invention and desire to secure by letters patent, is making the aperture for the escape of the products of combustion in or near the bottom, (not under the fuel,) and below the upper edge of the door, for the purpose and in the manner described. And I also claim the air passage below the fire-chamber, and connecting with the fire-chamber and escape pipe, or chimney, by the aperture for the escape of the products of combustion, for the purpose and in the manner described."

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4. For an *Improvement in the Straw Cutter;* Joseph C. Rich, Penfield, New York, January 7.

This is for a modification of that kind of straw cutters in which the knife is attached to a vertically sliding gate. The cutting edge of the knife, instead of being straight, is angular, running down obliquely either way from the middle, and to avoid the necessity of giving so long a stroke to the knife-gate to raise its ends above the straw in the box and passing through the feeding mouth-piece thereof, its upper edge is made with the same obliquity as the knife towards the ends, the middle part being horizontal.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the form of the mouth-piece, or face plate, in combination with the angular knife, as above set forth."

5. For an *Improvement in the Apparatus for Heating, Evaporating, and Concentrating Fluids;* J. J. Mapes and Wm. A. Cox, New York, January 7.

The bottom of this pan inclines in opposite directions from the sides to the middle, and just above the two inclined surfaces of the bottom, there are two series of parallel pipes, each series communicating at either end with a pipe at right angles, the one along the side of the pan to conduct steam to the upper end of the series of pipes opening into it, and the other near the middle to receive and discharge the steam and water from their lower end.

Claim.—"We claim the employment, within an evaporating pan, of a series of inclined tubes, in combination with an upper and lower box, or tube, the former communicating with the upper end of the series of inclined pipes for the admission of steam to them, and the latter with the lower end of the series, for the discharge of steam and water produced by condensation, substantially as described."

6. For an *Improvement in the method of Glazing Cotton Battings;* Darius Goff, Rehoboth, Massachusetts, January 15.

Claim.—"I wish it to be distinctly understood that I do not lay claim to this apparatus as it has been employed for saturating, with tar and other similar substances, battings made of hempen and other coarse fibres employed in sheathing vessels, &c., the object being thoroughly to saturate the fibres, to cause them to adhere to each other and to the cementing matter, with the view to form, as near as practicable, a water-proof fabric, the object and the fabric being entirely different from cotton or pelisse wadding; but what I do claim as my invention in the process of glazing the fabric known under the general appellation of pelisse or cotton wadding, is passing it through the glazing liquid at a velocity substantially as described, so as to cover the entire surface and edges without penetrating to the inner fibres, as described."

7. For an *Improvement in Clocks or Time-Pieces;* Thos. A. Davis, New York, January 15.

This is for making use of the weight of a clock and case as a substitute for the weights heretofore employed to carry the movement and striking part, which is effected by carrying the cords from the two driving drums up through the upper part of the case and uniting and hanging them over a loose pulley, so that the weight of the clock is hung to the cords, which, passing over a loose pulley, will always keep it balanced, irrespective of the motion of the two movements of the clock.

Claim.—"What I claim as my invention and desire to secure by letters patent, is suspending the case and parts of a clock or time-piece, as above described, in such a way as that the weight of the same will cause the working parts to go in the usual way, thereby saving the expense of the ordinary weight and springs as the motive power. I also claim the introduction of the pulley, as herein described, to regulate the weight between the time and strike sides."

8. For an *Improvement in the Bee Hive;* Harvey W. Sabin, Gorham, New York, January 15.

The patentee says,—"The nature of my invention consists in forming the honey boxes so that all the sides can be readily detached, (they go together with dowel pins, or other suitable contrivance,) so that said boxes can be lined with paper around the sides and bottom that is easily removed with the honey, the top of the box has a thin board under it, on which the comb is formed.

Claim.—"What I claim as new and desire to secure by letters patent, is constructing the honey boxes so as to be taken to pieces, in combination with covering them, in manner described, with paper, for the purposes set forth, having an additional or false top, on which the comb is to be built."

9. For an *Improvement in the method of Constructing India Rubber Boats or Pontoons;* Horace H. Day, New York, January 15.

The patentee says,—"My improvement consists in forming the boat of a sheet of India rubber for the bottom, extending around and attached to hollow cylinders of India rubber cloth, connected together by their ends to form the outer frame, or what corresponds with what are termed the 'gunwales' in ordinary boats."

Claim.—"I am aware that boats and pontoons have been formed of inflated cylinders of India rubber, connected together side by side, to receive a platform above them; and also that the outsides of boats have been made of India rubber cloth, distended by means of a wooden frame placed within; and therefore I wish it to be distinctly understood that I do not claim as my invention simply making boats of India rubber cloth, either with or without inflated cylinders; nor do I claim simply making boats with hollow air-tight vessels around the gunwales, as this has been resorted to in life-boats made of wood or metal; but what I do claim as my invention and desire to secure by letters patent, is making boats of a sheet or sheets of India rubber, or other water-proof cloth, attached to a frame consisting of inflated India rubber cylinders, in manner substantially as herein described."

10. For a method of *Softening India Rubber, and preparing it for Grinding;* J. W. Harmon, New York, January 15.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the softening of India rubber preparatory to grinding, by the use of the vapor of either turpentine or naphtha, combined with steam, as described."

11. For an *Improvement in Cooking Stoves;* Benjamin F. Dewolf, Lansingburg, New York, January 15.

Claim.—" What I claim and desire to secure by letters patent, is the horizontal passage between the outer plate of the oven and the inner bottom plate of the baking apartment, with the openings in and out of the same, together with the provisions by which the fire and heated air from the fire-chamber are made to pass through the same, in the manner and for the purpose described."

12. For an *Improvement in Bridges;* Thos. Hassard, New York, January 15.

The nature and object of this improvement will be clearly understood from the following

Claim.—" Having thus described the manner in which I construct my bridge and arrange the respective parts thereof, what I claim therein as new, and desire to secure by letters patent, is, first, the manner in which I combine the braces with the cord timbers, by means of the shoes and the caps attached to the posts, the shoes admitting wedges for keeping up the structure, and the whole combination being such as is set forth.

"I do not claim the use of cast iron shoes, such having been used to receive both the vertical posts and the braces, and not being capable of effecting the purpose for which I employ them in combination with posts that pass through the upper and lower cords."

13. For an *Improvement in the Bedstead Fastening;* Ebenezer F. Gazzaw, Pittsburg, Pennsylvania, January 23.

This is for an improvement in the method of fastening into the posts of bedsteads the metal plates which form the fastening for the rails, which is effected by making that part of the metal plate which is inserted into the post with a groove all around it, into which are laid strips of wood, so that the plate or nut can be secured by glueing,—the strips of wood being secured to the mortise in the post by glue, and the plate held to the strips by its flanches.

Claim.—" What I claim as my invention and desire to secure by letters patent, is the projection, or nut, on the inner surface of the plate now in use, and the peculiar arrangement, above described, of the wooden slats or strips, by means of which, the plate may be permanently fastened into the post with glue, thus saving the cost of screws and the time necessary to put on the plate by means of screws, and at the same time making a more complete and permanent fastening.

" I do not claim as mine the method of fastening the rail to the post, of which the plate described constitutes a part, but merely the above described method of fastening the plate itself into the post."

14. For an *Improvement in the Washing Machine;* Moses Chase, Baltimore, Maryland, January 23.

We are under the necessity of omitting the claim in this case, as it refers to and is wholly dependent on the drawings. The improvement consists of a combination of parts for operating a pendulous dasher, which vibrates within the wash box, and at the same time giving a vibratory motion to hinged flaps on each side of the dasher, that the clothes may be acted upon by the joint action of the dasher and these hinged flaps, and between them.

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15. For a *Vegetable Composition* to be moulded into various articles, such as handles, heads, &c.; Charles Branwhite, New York, January 23.

The following is an extract from the specification:—

"Take half a pound of starch and dilute it in one pint of cold water, then put one quart of water in a gallon open vessel, and let it boil,—then pour the diluted starch into the vessel, and when it again boils add 3 pounds of rye flour, and stir it well while on the fire, until the whole is well mixed together. When this mixture is cold take it out of the vessel and place it on a flat surface. Now take finely sifted dry mahogany saw-dust, (or, finely sifted wood ashes, or whiting may be used,) and stiffen the dough to the consistency of good putty, by working the whole together well with the hands. The composition is now ready for use."

Claim.—"What I claim as my invention and desire to secure by letters patent is the before described vegetable composition, for the purpose of making moulds, heads, and handles of every description, especially in the making of fringe and tassel moulds, parasol and umbrella handles or heads."

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16. For an *Improvement in the Machine for making Hat Bodies;* Wm. Fosket, Ware, Massachusetts, January 23.

In this machine, the fibres are to be deposited on a perforated or wire gauze former, or cone, by exhausting the air from the inside, the case being placed in a chamber in which the fibres of fur or wool are introduced by an endless apron, and thrown up by a bow.

Claim.—"Having thus explained my invention, I claim the combination with the wind chamber surrounding the conical frame of gauze, of the apparatus which feeds the fibrous material into the chamber, and whips, or prepares it, previous to its reception therein, the said apparatus consisting of the feeding apron, with its spring plate and bow-string; the whole being arranged and operating substantially in the manner as above specified and described."

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17. For an *Improvement in the Double Seaming Machine for making Tin Ware;* Joseph V. Hewes, Putnam, Indiana, January 23.

Claim.—"What I claim and desire to secure by letters patent, is the giving to one of the double seaming rollers a conical flanch, in combination with a spring attached to the shaft of said roller, in such manner that the flanch surrounding the bottom of a vessel can be gradually bent down, and the seam perfectly finished at one operation, the parts being constructed and combined substantially as set forth."

18. For an *Improvement in the Elevated Oven Cooking Stove;* Lathrop S. Bacon, Genesee, New York, January 23.

The flue around the elevated oven is divided into two parts by a partition, and the vertical flue leading thereto is divided into two parts by a vertical partition; one of the divisions having a pipe leading into the chimney, and each provided with a damper, so that the draught can be discharged directly into the chimney, or be carried around the oven first.

Claim.—"What I claim as new therein and desire to secure by letters patent, is the dividing of the wide elevating flue of the elevated oven, and of the flue space surrounding said oven, into two compartments, by the partition plate, in combination with the dampers and the exit opening in the flue; the whole being arranged and operating substantially as herein fully made known."

19. For an *Improvement in Transparent Covers for Stoves, Grates, Heaters, &c.;* Henry C. Billings, Trenton, New Jersey, January 28.

This is for making transparent covers for stoves, by means of two perforated plates that rotate on each other, that the solid parts of one may close the apertures in the other, in the well known manner of making registers; a plate of mica being interposed between the two metal plates.

Claim.—"I expressly disclaim the use of mica with register plates, and intend only to claim as my invention the manner of combining the plates, and plate of mica with the plates, arranged and operating in the manner set forth."

20. For an *Improved method of Cutting out Ladies' Dresses;* Hiram Seger, Macon, Georgia, January 28.

The patentee says,—"The nature of my invention consists in forming a couple of patterns: No. 1 being the shape of one half the front of the bodice of a lady's dress, from the centre of the front to a seam descending from the lower part of the arm-hole; and No. 2 being a pattern for one half the back of a bodice from the seam under the arm to the centre of the back. These patterns are laid off with scales, with holes through the same, the scales being placed in such positions, and the openings in the same for dotting through on to the cloth, being placed at such distances that the patterns can be reduced to suit persons of every size, and preserve the shape and proportions of the patterns, and adapt them to every shape and size of form of person."

Claim.—"What I claim as new, and desire to secure by letters patent, is the form of the patterns, Nos. 1 and 2, and the arrangement of the graduating open scales upon the same, for adapting the patterns to persons of different sizes, constructed and operating substantially in the manner and for the purpose set forth.

"I also claim the manner of applying the several measures taken in obtaining the size of a lady's form, by means of the patterns and scales, so as to shape the different parts of the body of a dress, substantially as set forth."

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21. For an *Improvement in Washing Machines;* Chas. King, Scipio, New York, January 28.

Claim.—"Having thus fully described my improvement, I wish it to be understood that I do not claim carrying the clothes around between a double series of rollers, placed in a circular form, as that has before been essayed; but what I do claim as my invention and desire to secure by letters patent, is the combination of a stationary set of rollers, placed in a cylindrical form, with a cylinder of rollers moving around within them, and having a play by means of the elastic springs, whereby the clothes are more perfectly washed, and remain uninjured during the process."

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22. For an *Improvement in Coloring Daguerreotype Plates, by fixing the Colors thereon;* Frederick Langenheim, Philadelphia, Pennsylvania, January 30.

The patentee says,—"In the invention of Isenring, for coloring plates, for which letters patent have been obtained, a difficulty arose in making the colors adhere, and it was found in practice that after a little handling, the color came off, and the picture was thus defaced. To remedy that defect is the object of my improvement.

"Either before the plate receives the color, or at the same time, I cause an impalpable powder of gum damarum, or other suitable resinous gum, to cover the parts to be colored, in the manner described in the patent granted to me as the assignee of Isenring, viz: by placing the plate in a close vessel, face up, with those parts covered that are not to be colored, and then filling the atmosphere contained in said vessel with the powder of gums above named, and allowing a sufficient quantity to settle, for the purpose intended; after the color is laid on the plates I submit it to a sufficient degree of heat to fuse the gum, which causes the color to adhere."

Claim.—"Having thus fully described my improvement, what I claim therein as new and desire to secure by letters patent, is fixing the colors on the plates by means of gum, applied substantially in the manner and for the purpose set forth."

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23. For an *Improvement in Coloring Daguerreotype Plates;* John B. Isenring, of Switzerland, assigned to Frederick Langenheim, Philadelphia, Pennsylvania, January 30.

The patentee says,—"The nature of my invention consists in coloring a daguerreotype picture by agitating a quantity of highly pulverized mineral, or other suitable color in a box, and then placing in said box the plate to be colored, having only such parts exposed as are to receive the color, the rest being covered by a stencil or other similar device, where it remains until the color settles upon it in sufficient quantities."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the process of depositing the color thereon, substantially as herein described, by causing the finely pulverized particles of color to float in the air over where the plate is placed, which, as they settle, are deposited on the uncovered portions of the plate, in the manner and for the purpose herein described.

"I also claim, in combination therewith, covering the picture with a stencil, as set forth, constructed in the manner and for the purpose described."

BIBLIOGRAPHICAL NOTICE.

Dr. Gardner's Memoir upon the Chemical Principles of the Rotation of Crops.

The Chemical Principles of the Rotation of Crops, a Memoir pronounced before the American Agricultural Association, March 4, 1846, by D. P. Gardner, M. D., Honorary Consulting Chemist of the Association. member of the Lyceum of Natural History, etc. Formerly Professor of Chemistry and Natural Philosophy, in Hampden Sydney College, Va.

The Essay with the above title has been published in the transactions of the American Agricultural Association, of which it occupies seventeen quarto pages. The subject is treated in a scientific, though very lucid manner, the main object being to point out and establish principles without dealing in nice details. Dr. Gardner has succeeded in condensing a very great amount of useful information in a small compass. He sets out with explaining the objects and necessity of rotation, and gives the views that have recently prevailed in relation to what is termed a natural rotation. Upon this last subject he says:

"The natural succession of plants is connected with the presence of organic matter in the soil. The richest weeds which first occupy the surface having the greatest necessity for it, and thus through successive groups to the grasses and forest trees which grow well without any portion in the soil. Other elements of fertility being present, the Chenopodiaceous and allied families thrive only in such localities as yield azotized matters, since they cannot grow without a supply from the soil. This surmise is not only sanctioned by the obvious presence of organic matters in the soils where they grow, and by the fact that some species exhale ammoniacal gases, but it is fully established by the experiments of Boussaingault. This chemist grew clover, peas, wheat, and oats in a soil completely destitute of organic matter and supplied them with distilled water only; the clover and peas were found to double their azotized matter during growth, whilst the oats and wheat gained none whatever. As there was but one source of azote present, the atmosphere, it is apparent that the former have the capacity of supplying themselves therefrom, whilst the grain plants are altogether dependent on the soil. Hence in a soil charged with organic matters, rich in azote, those plants which require a supply by their roots will grow freely, and so far exhaust it in time as to render it unfit for the species, which is succeeded by an intermediate class, and finally by the Graminæ, Leguminosæ, and others capable of subsisting on aerial azote, and so far from exhausting, adding it to the soil. From this function of plants, we see an explanation of the natural rotation, and what is of more moment, a means of adapting our succession of crops to the accumulation as well as removal of azotized matters."

By most of the French scientific agriculturists, including Boussaingault, and Payen, the value of manures is estimated according to the amount of azote they contain. With them, therefore, the great object of manuring is the application of azote to the soil, and the great, if not the sole, principle in rotations is the economy of this body. Crops are to be introduced in such order that after the application of the manure a highly exhausting plant as wheat may come, and this be succeeded by others of less affinity for nitrogen, and again by those which draw their supplies from the air and are the ameliorating crops of this class of agriculturists. The soil now recruited by clover, lucern, grass, etc., will bear another azotized crop, and the system is at an end.

There is something charmingly simple and plausible in this "one principle rotation," as Dr. Gardner terms it. But, he remarks, our corn, wheat and oats not only draw azote from the soil, but other bodies, namely, the inorganic and saline matters, much more of which is often withdrawn, than of azote. He refers to a paper read by him before the Association the previous year, containing the results of a thorough examination made by him into the nature of the exhaustion of lands by seed crops. The object of that communication was to prove the following points:

" 1. That all seeds contain an excess of phosphoric acid, amounting usually to thirty-five or forty per cent. of the entire ash, nearly the whole of the ash being in many cases phosphates ;this was demonstrated in the case of corn, wheat, beans, hemp seed, flax, peas, cotton, and other plants. It was also shown that the straw and haulm seldom contain more than one to three per cent. of phosphoric acid, this substance being segregated in the seed. For the analytical evidence of these positions I beg to refer to the Farmer's Dictionary, in which the admitted analyses of all plants hitherto examined will be found.

2. " That phosphoric acid is the least developed of all the mineral bodies of the soil, being seldom present to the extent of 0.5 per cent., and usually less than 0.1 per cent., in good soils.

3. " That many soils containing from five to twelve per cent. of humus are known to be steril.

4. " That the amount of phosphoric acid removed by given seed

crops far exceeds that removed by the ordinary forage crops, being often five times as great.

"The evidence of these positions was set forth at length in that communication and is therefore not worthy of repetition. The principle which I believe was fairly reached, and admitted, was that seed crops exhaust the soil of phosphoric acid—the deprivation of which is easily perceived, even in the best lands. It is not necessary for me to advance further evidence of this fact before your Association.

"If it be admitted that phosphoric acid is segregated in the seeds, it is evident that the exhaustion effected by foliage plants, as tobacco, cabbages, flax, hemp, etc., not intended for seed and of the root crops, with perhaps the exception of turnips, is due to another cause. The experiments of Boussaingault and our own observations on natural rotations will now throw light on this other kind of exhaustion. Some plants draw all their azote from organized matters in the soil, others from the air: some families of plants appear only on rich soils and around dung-hills, while others inhabit the mineral earth destitute of organic matters. It is evident that phosphoric acid has nothing to do with this peculiarity, for none is removed from the soil, the dead plants restoring it; there is a diminution only in volatile matters or in the azotized products of the decaying organic matter. Let us cultivate a few crops of cabbages or tobacco on a rich spot of land, how soon will the organic matter disappear! Practical men may tell us that this is because the crops are hoed and the soil exposed to the sun, but this is not the cause; the hoeing improves the plant because by introducing air it hastens the decomposition of the organic matters of the soil or assists the fixation of atmospheric nitrogen. (*See Mulder Journ. für. Pract. Chem.* XXXII. p. 344). When putrescent manures are added to tobacco, potatoes and similar crops, the indication is to furnish azotized matters, and is altogether different from the object in view when it is added to wheat and certain grain crops. But if this point requires further evidence we may appeal to those plants which exhaust the soil differently under different circumstances. A flax crop raised for its fibre exhausts the soil of azote and may be followed by corn or beans, but if it be allowed to mature seeds it exhausts the soil doubly of azotized matter and phosphoric acid, and cannot be succeeded by corn except in the richest soils. Hemp raised for fibre may be cultivated many years in a soil containing much humus but the seed crops are rapidly exhausting.

"Hence we have crops which exhaust the soil of azotized matters—crops which remove an excess of phosphoric acid—and grasses and clovers, cut before bearing seeds, which exhaust the soil of neither of these essential bodies but on the other hand enrich it in organic matters. Many cultivated plants, as corn, wheat, cotton, hemp, flax, cabbages, etc., raised for seed, exhaust in both respects and are therefore peculiarly expensive crops. With this amount of information, based on experience and several hundred analyses, we have the means of rendering intelligible the precepts of practical writers on the succession of crops.

"Precept first resolves itself into the principle, that plants exhaust the soil unequally in respect to azotized matters and must therefore be so adjusted that the most exhausting should recur as seldom as possible.

" Precept second. Seed crops, which exhaust the soil of phosphoric acid, are to be interchanged with herbage plants, which do not remove as much of this important substance.

"These directions have now assumed a definite form and are an explicit guide to the well informed farmer; he at once perceives that there are, over and above the precepts of expediency as to hoed or cleaning crops and deep rooted crops, classes of plants which differ remarkably from each other in their action on his fields. 1. Seed crops which exhaust the soil of azote. 2. Seed crops which do not exhaust the soil of azote. 3. Exhausting forage and root crops. 4. Crops which neither exhaust the soil of humus nor phosphates, but renovate the azote. With this amount of knowledge he can shape a fair system of rotation, whatever may be his crops—he can introduce indigo, cotton, tobacco, corn, bene, oil plants, and many others which are not found in the arbitrary tables given by Low, THAER, and STEPHENS, or falsely placed by BUEL and ARMSTRONG. But if we recur to our definition of the object of a rotation—the production of the greatest profit in crops, with the least exhaustion of the soil or manure—we find that there is yet something wanting in the principles of rotation. In the fourth class above, we have plants which neither exhaust the soil of azote nor phosphoric acid; it now becomes necessary to know in what respect they do exhaust it, so as to satisfy the economical condition of impoverishing the soil in the least degree."

In addition to the well known affinity of plants for phosphoric acid, without which they cannot ripen their grain or seed, chemical analyses, now extended to several hundred subjects, show the precise substances or alkaline bases taken up by different individuals. The classes which prefer *potash* are the composite, umbelliferous, amentaceous, gramineous, and chenepodiaceous; those which most affect *lime*, are the leguminous, rosaceous, solanaceous, and rubaceous; those selecting *soda* are the families of crucifera, asphodelœ, and liliacea.

In thus grouping plants with relation to the mineral bases which they most affect, it is necessary to bear in mind the existence of what has been termed an isomorphism amongst many of the mineral bodies. Isomorphism may be defined the connection between the external form and the chemical composition of bodies. Isomorphous substances are those which possess the property of mutually replacing one another in combinations without varying the form of the same. Thus—potash, soda, oxide of ammonium, and hydrate of lime—lime and magnesia—sesqui-oxide of iron, sesqui-oxide of manganese and alumina—sulphuric and selenic acids—phosphoric and arsenic acids—are respectively enumerated as isomorphous groups, that is to say, soda may replace potash; hydrated or slaked lime may be present in place of either soda or potash. In proof of this, soda has been found by chemical analyses to replace potash in the ashes of the oak on the sea coast of Long Island. Grapes cultivated near the low salt plains of New Jersey have been found to contain soda instead of potash. On the other hand, marine plants transplanted to an interior situation are found to contain potash. Tobaccoes from various sources, analyzed by Berthier, yielded potash as a base, whilst specimens examined by Fresenius and Will, yielded 60 per cent. of lime and magnesia.

It must also be observed that the different parts of the same plant yield an excess of dissimilar salts. The potato tuber contains 80 per cent of potash,—whilst analysis of the tops gives 61 per cent. of lime. Chemical examinations of different plants will therefore show different results with the same plant raised upon different soils, or at different times in the same soil. The French government agents, finding a great depreciation in the tobaccoes imported from the United States, set about an investigation, which resulted in showing that in the place of the salts of potash formerly obtained in the good specimens analyzed by Berthier, the salts of lime predominated in the inferior specimens of more recent growth.

Dr. Gardner thinks that in determining the place of a plant in the saline groups, the ashes of the leaves should be selected as the true guide, chiefly because the leaf is the important organ of vegetation in which the sap is elaborated, and the future growth of the plant provided for. If the view of Raspail be correct, that the presence of saline matters in tissues, is the essential of their organization and true source of their distinction from the mere proximate principles of which they are composed, it is a necessary consequence that the organizing portion of the plant—the leaf—should contain the essential saline matters, without which, or other isormorphous substitutes, it could not be developed nor carry on its functions; and if the leaf does not flourish, the plant cannot attain perfection.

With regard to the influence exerted upon plants by cultivation, Dr. Gardner observes,—

" Under natural circumstances all the grain-bearing plants require little azotized matter, but from the development which many, such as wheat and barley, have acquired, they have become azotized plants, and are not to be maintained in their present state without a large supply of this food made to the roots. Many garden vegetables are also of this kind ; the cabbage in nature consists of a few tough leaves and inhabits soils of ordinary fertility on the sea side ; its present luxurious development, by which it attains a weight certainly a hundred times greater in several varieties, is the result of supplying food to the root in tillage, and if the supply be diminished the characters of the variety are soon lost and the vegetable degenerates.

"The following table will show the position of most cultivated plants, so far as evidence exists at present. The conditions under which the classification has been made should be borne in mind.

Plants requiring much azote in the soil,	Seed bearing,	Lime,	Hemp seed, Cotton, Hop, cultivated Peas,
		Potash,	Corn, Madia, Wheat, Rice, Oats, Barley.
		Soda with Sulphur,	Rape seed, Colza, Mustard seed, Linseed.
	Foliage or root crops,	Lime,	Tobacco, Potatoes, Hemp, Indigo, Madder.
		Potash,	Sugarcane, Carrots, Parsnips, Mangel-wurzel, Beets, Spinach.
		Soda with Sulphur,	Turnips, Kohlrabi, Ruta baga, Cabbages, Onions, Asparagus.
Plants requiring little or no azote in the soil,	Seed bearing,	Lime,	Field Beans, Pindars, Vetches.
		Potash,	Rye, German and Polish Millet, Buckwheat.
	Foliage or root Crops,	Lime,	Pomaceous fruits, Lupius for fallowing Clovers, Spurry, Lucern, Sainfoin; all cut before seed.
		Potash,	Meadow Grasses, Jerusalem Artichoke.

"Thus the table presents ten groups of plants to be employed in a rotation, which are variously exhausting of saline matters, and exhausting or ameliorating as respects azote."

The fitness of a farm to produce remunerating crops may, for the most part, be estimated from an examination of the preceding table. In converting the minerals of the earth into crops, we must adopt such a system of rotation as will not exhaust the bases of fertility too rapidly, without compensation from some source. If, in a situation where every product is marketable, we adopt a series of rotation in which the crops draw from the earth only phosphoric acid, the purchase of azote, lime, potash, and sulphur, would be of no advantage but, on the contrary, just so much money spent unprofitably. By a judicious succession of crops however, each fertilizing agent in the soil may be converted into money without loss or improvidence.

"As," in the language of Dr. Gardner,—"we have paid for every kind of plant-food in the earth, we incur a loss by allowing any part to remain unappropriated.

"The farm having reached its high point of tillage, by suitable means, is now to be cropped for profit, and reduced thereby to a practical standard—what are the general principles on which this cropping is to be conducted? Obviously by a system of rotation, during which every saline and azotized matter that becomes soluble is removed, and no part is wasted. This can be accomplished only by introducing such crops as have severally an affinity for the various kinds of plant nutriment, and adapting them to the proportion of food present in the soil. Phosphoric acid is the rare ingredient of soils and manures, excepting guano and bones, the former of which contains

12 and the latter 25 per cent. of this body. Next after this is the azotized matter which forms a small per centage of vegetable mould (0. 5 to 3. 0 per cent,) and is therefore to be removed cautiously. Sulphuric acid is present to some extent in all soils, abounding most in ancient marls and gypseous formations. The supplies of lime and alkalies are very much greater than any of the preceding bodies; the former attaining 10, and the latter 4 to 5 per cent. in rich alluvial lands. The extent to which we may remove these in a rotation is as their probable amount in the soil, which may be taken in general terms after the following rates per cent. in a perfect alluvial soil. Phosphoric acid 0. 20—azotized matter 0. 25—sulphuric acid 0. 10—alkalies 2. 00—lime and magnesia 5. 00. In estimating the consumption we must know the amount and kind of bodies removed with each crop. The difference of average crops in this respect is remarkably striking, and the subject has been fully detailed in my lectures in the University. It may be proper, here, to adduce by way of illustration, a few cases. A crop of wheat of 25 bushels with straw removes 123 lbs. of inorganic matters, consisting of about 12 lbs. of phosphoric acid, 90 lbs. of silica, 15 lbs. of alkaline salts. A crop of lucern of two tons removes 425 lbs. of mineral bodies, of which about 250 lbs. are lime, 20 lbs. sulphuric acid. Eight hundred bushels of beets remove about 360 lbs. of ashes, of which 316 lbs. are alkaline salts.

"It would be tedious and out of place to read here the tables upon which these calculations are made; it may be enough to state that they have been made, and that they form one of the necessary items of knowledge in constructing a perfect rotation. In addition to this, every expedient used by practical men, as the introduction of cleaning crops, green fallows, depasturing fall crops, the employment of roots, etc., are to be attended to in carrying out the design of the rotation—the economy of the mineral and organic aliments of the soil."

Dr. Gardner pays a just tribute to the Norfolk system of rotation, the general adoption of which in many parts of England has raised entire counties from sterility to the highest state of prosperity. "It consists of the following succession : first year, manure, followed by turnips; second year, barley sown with clover; third year, clover, the first crop cut, then depastured and ploughed for wheat; fourth year, wheat, succeeded by manure and turnips, as before. In this system the manure is followed by the plant requiring the most azotized matter. It is also a soda and sulphuric acid crop. Barley, the second crop, requires very much less azotized matter and exhausts the soil of only a limited amount of phosphoric acid and potash. This is succeeded by a lime plant, clover, which recruits the azotized matter and loosens the soil by its long roots. Wheat, which completes the rotation, is a potash and phosphoric acid crop, requiring a medium supply of organic matter. This rotation, when we consider the soil and the manures used, the former siliceous and the latter farm-yard compost and bone earth, is a perfect embodiment of the foregoing principles. Reached entirely by experimental means, it is strictly conformable with science; and is a striking illustration of the correctness of the doctrine, that rotations form a chemical study, which, originating with CHAPTAL, has been maintained to our day."

He concludes his highly interesting memoir by presenting examples of five year rotations, adapted to peculiarities of soil, etc., in the United States. The plants he proposes for the several soils are indicated by the probable excess of mineral matters and phosphoric acid therein. "The crops which may be substituted are placed vertically under the principal plant. There is in the rotation for clay soils, a mechanical impediment, arising from the difficulty of keeping them in tilth, which influences the plan; and in sandy soils, also, it is necessary that too many hoed crops be not introduced, and that grazing be practised to render the soil compact. The rotations given are applicable north of Carolina."

I. *A Rotation for Good Mixed Soils.*

	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.
Manure—or the soil in the highest condition.	Corn.	Oats, Clovers, Rye, Grasses, Barley.	Clovers, Grasses.	Potatoes.	Wheat, Carrots, Oats, Parsnips. Barley.

II. *A Rotation for Rich Calcareous Soils.*

	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.
Manures, etc.	Potatoes, Hemp, Tobacco.	Wheat, Clovers. Barley,	Clovers.	Corn, Beans.	Oats, Rye.

III. *A Rotation for Rich Siliceous Soils.*

	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.
Manures, etc.	Turnips, Rutabaga, Beets, etc.	Rye, Grasses, Oats, (Spurry,) Barley.	Grasses fed off, (Spurry,) " "	Corn, Wheat Buckwheat.	Jerusalem artichoke, Rye.

IV. *A Rotation for Clay Soils.*

	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.
Manures, etc.	Corn.	Oats, Clover, Rye, or Grasses.	Clover, Grasses.	Potatoes, Beets.	Wheat, Oats, Barley, Beans.

MECHANICS, PHYSICS, AND CHEMISTRY.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Manufacture of Metallic Pens.

Although millions of metallic pens are consumed in Europe and other parts of the world, yet the manufacture of them is little understood, and almost exclusively carried on in England.*

The principle of this manufacture is extremely simple, nevertheless, the operations necessary to bring this small article to the state in which we see it, are more complicated than we should be led to expect. The following is the information on the subject which we have been able to collect:—

The material of which metallic pens is made, consists, in general, of plates of steel of the same thickness as that of the pen when finished. These steel plates are from 1·25 m.† to 1·50 m. long by from 0·60 m. to 0·90 m. wide. They are cut by a machine entirely similar to that used for cutting the paste-boards for Jacquard looms, into bands or strips, the width of which is about double the length that each pen should have when finished.

These strips are taken to the cutting-press, which nearly resembles the fly-press used in coining, but is smaller and more simple. A young girl takes, with the left hand, one of the loaded levers of this press, and with the right hand pushes successively the metallic strips on to the die or matrix of the press.

When this operation is completed, the work-woman strikes a blow with the press, which cuts out many blank pens at a time, these are so placed in two rows, that the point of one of the pens of the one row is cut out of the interval that separates two adjoining pens of the other row, and so reciprocally. The die which lies below, and the counter-die, which the screw of the press successively raises and lowers, have forms corresponding to the number and pattern of the pens that are to be cut at one blow. As soon as the blow is struck, the work-woman draws back the lever, the cut-out blank pens fall into a box placed to receive them; the work-woman pushes on the strip of steel, and the same operation is repeated.

A young girl can, in this manner, cut out 300 blank pens in a minute.

The pens, in this state, are taken to another work-woman, whose business it is to pierce the hole which they are to have near their centre. This hole is made by a press exactly like that used to cut out the pens, but smaller. The piercer, or punch, has the shape of the hole intended to be made, and the matrix has a corresponding cavity.

The blank pens just cut out, being placed to the left of this work-woman, she takes a certain number of them in her right hand, which she holds by the fingers by the widest part, opposite to the point; she introduces this point between the dies, until she meets with a resistance caused by a stopper, she then adjusts it, fixes the pen in its place by means of a small elevation on the counter-die, so arranged, as that not only the point, but also its oblique edge, exactly fit it, and the pen is placed in a fixed and determined position under the screw of the press. In this position, the work-woman strikes the blow with the fly-press, pierces the hole, and whilst, with the same hand, she draws back the lever, with the right she throws to the same side the pierced pen, which had been held firmly during the operation, and immediately, with quickness and dexterity, replaces it with another, which is to be similarly treated.

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* *Note by the Translator.*—The manufacture of metallic pens is carried on extensively in the United States.

† The *metre*, which is the measure adopted in this paper, is equal to 39·371 English inches.

These pens, thus pierced, pass into the hands of a third work-woman, who makes the two lateral slits, which give them the necessary elasticity. This operation is performed exactly in the same manner as the preceding.

Among all the before mentioned operations, none presents more difficulties than the cutting or sinking of the dies and counter-dies, and their adjustment in the press. These require, in fact, much ability, care, and exactness; but when once good tools are prepared, the manufacture may go on steadily, furnishing products of a good quality, and always of the same pattern.

The next process is to round the pens, that is, to give them a semi-cylindrical form. For this purpose, the counter-stamp has a cavity corresponding to the shape which the pen is to have. The work-woman takes the pens and pushes their open and slit extremities as far as a stopper will permit, on to this counter-stamp, and then, by means of a blow of the press, brings down the stamp, which is so shaped as to give the pen the necessary curve.

As soon as the pen has received the proper curvature, the slit at the point, which causes the ink to flow, must be made. This delicate operation is little known, and many persons have, till now, supposed that it was performed by stamping, exactly as in the usual way, that is, by means of a kind of blade or knife, which, after having cut the slit in the pen, was to enter into a corresponding slit in the counter-stamp; but it would appear, on the contrary, that it is effected by tools which operate rather like the blades of a pair of scissors, than like parts of a stamp, properly speaking. The counter-stamp, in this case, acts as one of these blades, whilst the stamp takes the place of the other. Between these blades, the blank pen is fixed in a proper position to make the slit, which is cut rather successively, than slit, and the piece taken out at a blow.

When the pens are brought to this state, we are assured that to smooth off the too-sharp edges, they are filed by hand with fine files by some manufacturers, whilst others roll them in parcels in the powder of emery, or other hard stones. Finally, it appears to be certain that the points are smoothed and rounded off on a hone, or rather on a soft grindstone, in order that they may not tear the paper.

However this may be, when the pens have acquired the necessary perfection, they are thrown in a mass into a cast-iron pot, in which they are heated in a furnace to redness; in this state, they are immediately plunged into a vessel containing a composition into which gum lac enters. After remaining twenty-four hours in this composition, they will have received the required color. They are then placed in an apparatus similar to that used in Paris for roasting coffee, mixed with a small quantity of fine sand, and are turned round in it until, by the continued motion and the friction of the sand, the excess of gum lac has been removed, and they have received all the brilliancy of which they are susceptible.

Account of the Staffordshire Potteries, with a History of the Art.

Continued from page 65.

The clay being prepared, we will next consider some of the multifarious modes of operation by which it is converted into objects of use and ornament; and our first visit shall be to the THROWER, rather for the sake of preserving continuity in our remarks on the several processes, than in the hope of conveying new information to the reader; for there are few unacquainted with the wonder-working powers of "the potter's wheel." A ball of clay is placed on the centre of the revolving wheel, and by the simplest manipulation is made to spring at once into form and character, assuming at the operator's will any contour of which a circular vessel is capable, the plastic clay being formed or transformed with an ease almost incredible. Every "piece," when made, is cut off the wheel by a wire being passed under it.

When the *thrown* ware is sufficiently dry, it is transferred to the hands of the TURNER, whose business it is to finish it by forming the angles and curves more truly, and to impart a general smoothness and polish to the surface. This process resembles that of common wood-turning, but, from the nature of the material, is executed with greater ease and rapidity. The vessel is fitted upon a block, or chuck, attached to the lathe, and the turning is performed by means of thin iron tools—few in number and simple in form.

Articles that require handles are passed from the lathe to the workshop of the HANDLER. These useful adjuncts are made by pressure in moulds, made of gypsum, and, after being sufficiently dried, are fixed on the vessel with "slip." The adhesion is so immediate and perfect that in most cases the article may be lifted by the handle, without danger, before it has left the bench of the operator. When the handle is fitted the superfluous slip is removed with a sponge, and the parts of junction smoothed round with a small tool; the article is then finished, unless a spout or lip is required, as in the case of jugs and tea-pots. These are made and attached in the same manner as the handles.

Plates, dishes, saucers, &c.,—termed FLAT PRESSING—are made from moulds, which form the inside of the article, the exterior being given by "profiles" made of fired clay glazed. The clay is "batted" out to the required thickness and size, and laid upon the mould, which is placed upon a plaster block, having an iron axis and working upon a pivot, the rotary motion of which is given sometimes by machinery, but more often by the workman's hand. The clay is worked to the mould by the application of wet sponges, and the profile being pressed on gives the desired outline. In this state the mould is carried to a chamber, immediately behind the workman, heated to a very high temperature,* and fitted round with shelves, where it remains till tolerably dry, when the profile is again passed over it, and the shrinking, consequent upon evaporation, having taken place, it is easily removed from the mould.

Soup-tureens, sauce-tureens, jugs, teapots, &c.,—termed HOLLOW WARE—are made from outside moulds, formed in two or more parts, according to the facilities which the shape affords for "drawing." The clay is prepared and batted out as in the "flat" pressing, and each part of the mould being separately lined with the clay, the parts are fitted together, and a strap passed round to secure them in their places: the whole is then worked compactly together from the inside, with sponge, particular attention being paid to connect firmly that part of the article where the mould is divided. When sufficiently dry, the mould is removed, and the seams on the article well rubbed down: the surface is also smoothed with a sponge.

The ware, being finished from the hand of the potter, is brought by him upon boards to the "GREENHOUSE," so called from its being the receptacle for ware in the "green," or unfired state. It is here gradually dried for the ovens; when ready, carried to the "SAGGER-HOUSE," in immediate connexion with the oven in which it is to be fired, and here it is placed in the "saggers." These are boxes made of a peculiar kind of clay, *(native clay,)* previously fired, not fusible at the heat required for the ware, and of forms suited to the articles they are to contain. A plate sagger will hold twenty plates, † placed one on the other. A little dry pounded flint is scattered between them if china, and sand if earthenware, to prevent adhesion. The purpose of the sagger is to protect the ware from the flame and smoke, and also for its security from breakage, as in the clay state it is exceedingly brittle, and requires great care in handling when dry, or what is called "white." The "setters" for china plates and dishes answer the same purpose as the saggers, and are made of the same clay. They take in one plate or dish each, and are "stood" in the oven in "bungs," one on the other.

The hovels within which the ovens are built form a very peculiar and striking feature in the appearance of the Pottery towns, and for-

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* The following are the degrees of temperature in which the different branches work:—

Platemaker's hothouse,	108	degrees	Fahrenheit.
Dishmakers' "	106	"	"
Saucermakers' "	100	"	"
Throwers' "	98	"	"
Pressers' shop,	90	"	"
Printers' shop,	94	"	"

Those branches against which the temperature of the hothouse, is placed require that heat for drying their work and getting it off the moulds; the outer shops, in which they work the clay, may be from five to ten degrees less.

† This applies to earthenware plates. *China* plates are fired *separately*, in setters made of their respective forms.

cibly arrest the attention and excite the surprise of the stranger, resembling, as they closely do, a succession of gigantic beehives. They are constructed of brick, about forty feet diameter, and thirty-five high, with an aperture at the top for the escape of the smoke. The ovens are of a similar form, about twenty-two feet wide, and eighteen to twenty-one feet high, heated by fire-places or "mouths," (about nine in number,) built externally around them. Flues, in connexion with these, converge under the bottom of the oven to a central opening drawing the flames to this point, when they enter the oven; other flues termed "bags," also pass up the internal sides to the height of about four feet, thus conveying the flames to the upper parts. An aperture in the top allows the escape of smoke. When "setting in" the oven the firemen enter by an opening in the side, bringing the saggers with the ware placed as described; these are piled upon one another from bottom to top of the oven, care being taken to arrange them so that they may receive the heat, (which varies in different parts,) most suited to the articles they contain. This being continued till the oven is filled, the aperture is bricked up. The firing of earthenware bisque continues sixty hours, and of china forty-eight.* The ware is allowed to cool very gradually in the ovens for two days, when it is drawn in the state technically called "biscuit," or "bisque."

The ware when drawn from the oven is carried to the bisque warehouse, where it is examined, sorted, and put aside for further use. In this state it is ready for glazing, excepting when it is required for "printing," or a common style of painting, both of which processes are effected in the bisque. Of the painting it is only necessary to say that it is applied in this state merely for cheap decoration, but extremely coarse in comparison with the painting on the glaze termed enamelling.

There are two distinct methods of PRINTING in use: the bisque printing in general use, and the other on the glaze. The first is called "press-printing," and the latter "bat-printing." The pattern or subject is engraved upon copper-plates of different depths and degrees of finish, according to the style required. For the press it is engraved very deep, to enable it to hold a sufficiency of color to give a firm and full transfer on the ware. The printer's shop is furnished with a brick stove, having an iron plate upon the top, immediately over the fire, for the convenience of warming the color while being worked; a roller press and tubs of water. The printer has two female assistants, called "transferrers," and also a girl called a "cutter." The copper-plate is charged with color, mixed with thick boiled oil, by means of a knife and dabber, while held on the stove plate for the purpose of keeping the color fluid; and, the engraved portion being filled, the superfluous color is scraped off the copper with the knife; and it is further cleaned by being rubbed with a "boss," made of leather. (A thick firm oil is required to keep the different parts of the design from flowing into a mass or becoming confused when under the pressure of the rubber in transferring.) A sheet of paper of the necessary size and of a peculiar texture, called "pottery tissue," after being saturated with a solution of soap and water applied with a brush, is placed upon the copper-plate, and, being put under the action of the press, the paper is carefully drawn off again (the copper being placed on the stove,) bringing with it the color with which the plate was charged, constituting the pattern. This impression is given to the cutter, who cuts off the superfluous paper about it; and if the pattern consists of a border and centre, the border is cut away from the centre as being more convenient to fit to the ware separately. The impression is then laid by the transferrer upon the ware, is rubbed first with a small piece of soaped flannel to fix it, and afterwards with a rubber formed of rolled flannel. This rubber is applied to the impression very forcibly, the friction causing the color to adhere firmly to the bisque surface, by which it is partially imbibed. It is then passed to the other transferrer, who immerses it in a tub of water, and with a sponge washes the paper entirely away; the color, from its adhesion to the ware, and being mixed with oil, being unaffected by the water. It is now necessary, prior to glazing, to get rid of this oil, which is done by submitting the ware to a heat in what are called hardening-kilns, sufficient to destroy it, leaving the color pure. (This is a necessary process, as the glaze, being mixed with water, would be rejected by the print while the oil remained in the color.*)

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* The quantity of coals necessary for firing a bisque oven is from sixteen to twenty tons; for a "glost" oven, from four and a half to six tons.

Connected with this branch of the subject is "BAT-PRINTING," which is done upon the glaze. The engraving for this style is exceedingly fine; indeed, many plates we have seen are as highly wrought as book plates, and executed by the best engravers; not unfrequently engraved in London. No greater depth is required than for ordinary book engraving; indeed, very good impressions have been taken from some of the copper-plates engraved for the "Annuals." As the impression is not submitted to the heat necessary for that on the bisque, the medium of conveying it to the ware being also much purer, the copper-plate is first charged with linseed oil, and cleaned off by the hand, so that the engraved portion only retains it. A preparation of glue being run upon flat dishes, about a quarter of an inch thick, is cut to the size required for the subject, and is then pressed upon it, and being removed, draws on its surface the oil with which the engraving was filled. The glue is then pressed upon the ware, with the oiled impression next the glaze, and being again removed, the design remains, though, being in a pure oil, scarcely perceptible. Color, finely ground, is then dusted upon it with cotton wool, a sufficiency of which, adhering to the oil, leaves the impression perfect, and ready to be fired in the enamel kilns.

The materials comprised in the various GLAZES, for china and earthenware are—Cornish stone, flint, borax, white lead, glass, and whiting: these, having been ground together in proper proportions to the consistence of milk, form the glaze.† This process is effected in large buildings termed "dipping-houses," (china and earthenware being kept separate,) fitted up with tubs for the glaze, and stages for the reception of the ware when dipped, upon which it is dried and heated by a large iron stove called a "cockle," from which iron pipes, extending in various directions, convey the heat throughout the whole extent of the "houses." Each dipper is provided with a tub of glaze, in which he immerses the bisque ware. We may note the results of practice and experience in giving facility and dexterity of handling, so necessary to success in this process. The ware is held so that as small a portion as possible shall be covered by the fingers; it is then plunged in the glaze, which, by a dexterous jerk, not only covers the entire piece, but at the same time so disperses it that an equal and level portion is disposed over the whole surface, which, being porous, imbibes and retains it. The ware is handed to the dipper by a boy; another boy removes it when it is dipped. The glaze is opaque till fired, so that the design of printed patterns is completely hid after dipping till they have been submitted to the glost fire.*

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* A good printer is considered capable of taking off from twenty to twenty-five dozen plates per day.

† "The glaze is so composed as to be suited to the nature and quality of the ware to which it is intended to be applied—the preparation is effected by previously fusing together the different substances of which it is composed, so as to form vitreous masses; these are afterwards broken up and ground very finely in a mill."

The GLOST OVENS and process of FIRING are so similar to the descriptions given of the bisque firing that there is nothing worthy of remark except the difference of time in firing—china glost being fired 17 hours, and earthenware 15 hours. When drawn from the glost ovens the white ware is ready for the decorative branches of painting, gilding, enameling, &c., &c.,: the bulk of common printed ware, is, however, finished at this stage.

In describing the further processes of ENAMELING, we shall commence with "GROUND-LAYING," † as being the first in operation in all the designs in which it is introduced.

This branch is extremely simple, requiring, principally, delicacy and lightness of hand; the process is effected by a coat of oil adapted to the purpose, being laid upon the ware with a pencil, and afterwards leveled, or, as it is technically termed, "bossed," ‡ until the surface is perfectly uniform, as the deposit of more oil in one part than another would cause a proportionate increase of color to adhere, and consequently produce a variation of tint. This being done, the color, which is in a state of powder, is dusted on the oiled ground with cotton wool, to which it attaches itself, and the superfluity is cleared off by the same medium. If it be requisite to preserve a panel, ornament, or indeed any object, white upon the ground, an additional process is necessary, called "stenciling." The stencil (generally a mixture of rosepink and sugar and water,) is laid on in the form desired, so as entirely to protect the surface of the ware from the oil; it is then dried, and the process, as previously described, ensues. It is then dried in an oven, to harden the oil and color, and then immersed in water, which penetrates to the stencil, and, softening the sugar is then easily washed off, carrying with it any portion of color or oil that may be upon it, and leaving the ware perfectly clean. It is sometimes necessary, where great depth of color is sought, to repeat these labors several times. The "ground layers" do generally, and should always, work with a bandage over the mouth, to avoid inhaling the color-dust, much of which is highly deleterious.

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* An able workman will dip about 700 dozen plates in a day.

† "The term given to the process by which the level surfaces of various colors so extensively introduced upon decorated porcelain is effected."

‡ The "boss" is made of soft leather.

We now arrive at the more elaborate and costly processes of PAINTING and GILDING. The colors* used are mineral preparations, (worked in essential oils and turpentine;) and a very great disadvantage under which the artist labors is, that the tints upon the palette are, in most cases, quite different from those they assume when they have undergone the necessary heat, which not only brings out the real color, but also, by partially softening the glaze and the flux, causes the color to adhere to it. This disadvantage will be immediately apparent in the case where a peculiar delicacy of tint is required, as in flesh tones for instance. But the difficulty does not end here: for, as a peculiar and certain heat can alone give to a color its perfect hue, and as the color is continually varying with different stages of heat, another risk is incurred—that resulting from the liability of its receiving the heat in a greater or less degree, termed "over-fired," and "short-fired." We will cite rose color or crimson, which, when used, is a dirty violet or drab; during the process of firing it gradually varies with the increase of heat from a brown to a dull reddish hue, and from that progressively to its proper tint of rose; but if, by want of judgment or inattention in the fireman, the heat is allowed to increase beyond that point, the beauty and brilliancy of the color are destroyed, and it becomes a dull purple. On the other hand, should the fire be withdrawn too early, the color is presented in one of its intermediate changes, as already described. Nor must we forget to mention the liability to cracking and breaking in the kilns, by the heat being allowed either to increase too suddenly, or withdrawn suddenly; of course the larger and more costly articles are peculiarly hazardous. These vicissitudes render enamel painting in its higher branches a most unsatisfactory and disheartening study, and enhance the value of those productions that are really successful and meritorious.

The gold, being prepared for use, (in which state it is a black dust,) is mixed with oils similar to the vehicle used in painting, and is worked with the ordinary camel's hair pencil. It flows very freely, and is equally adapted for producing broad, massive bands and grounds, or the finest details of the most elaborate design. To prevent the necessity and expense of drawing the pattern upon every piece of a service where it is at all intricate, a "pounce" is used, and the outline dusted through with charcoal; this method also secures uniformity of size and shape. Women are precluded from working at this branch of the business, though, from its simplicity and lightness, so well adapted for them; the men resolutely opposing any attempts to infringe this "ancient regulation"—one that would be surely more honored in the breach than in the observance. Firing restores the gold to its proper color; which first assumes its character as "dead gold;" its brilliancy being the result of burnishing.

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* The colors are metallic calces, incorporated with a very fusible flux; gold precipitated by tin, furnishes the crimson, rose, and purple; oxides of iron and chrome produce reds; the same oxides give black and brown, also obtained from manganese and cobalt; orange is from oxides of uranium, chrome, antimony and iron; greens from oxides of chrome and copper, the former class being by far the finer; blues from oxides of cobalt and zinc; the fluxes are borax, flint, oxide of lead, &c.

The ware being ready from the hands of the painters, gilders, &c., is carried to a receiving-room in connexion with the ENAMEL KILNS. The firemen select the ware from this room, according to the degree of heat it may require, and place it in that part of the kiln most likely to secure it. The different articles are ranged upon stages constructed of slabs or bats supported on props, all made of fired clay. The time of firing is from six to seven hours, according to the size of the kiln, and whether it contains any pieces of ware of unusual size and hazard, in which case the heat is brought forward very gradually. The "ground-laying" being executed with colors less fusible than those employed by the painters; the ware so decorated is fired in separate kilns, and at a greater degree of heat—a level, glossy surface being a great desideratum; and, as gold is often used as a decoration upon the "grounds," it would be liable to sink unless the under color had been capable of enduring a greater heat than is required by the gilding. The kilns are formed of large clay slabs made of a common clay expressly for this purpose; they are about 3 feet 6 inches wide, 4 feet 6 inches high, and 6 feet 6 inches long, with circular tops, and having flues beneath and around them: the fire-places, or mouths, are at the sides, and the flames passing through the flues encircle the kiln *externally.* Great care is taken to prevent the admission of smoke or flame into the body of the kiln, the fronts of which are enclosed by iron doors, having in them small holes, through which the firemen, during the firing, occasionally draw trials of color made upon small pieces of ware, and thus ascertain to a certain extent the progress of the heat. This, though a material assistance, still, being drawn from a particular part only, leaves a task requiring great care and nicety of judgment to manage successfully. Gold if not sufficiently fired will wipe off, and if overfired will not burnish.

The operation of BURNISHING is performed by females: the tools used for the purpose, called burnishers, are bloodstones, from hæmatite iron and agates, fitted into handles. The gold is first scoured with fine wetted sand, which tests the extent of the firing: if not sufficiently, the gold will not adhere, and therefore has to be repaired and passed through the kilns again; and if it be over-fired, the brilliancy will be destroyed, and it requires to be thoroughly regilt. After sanding, the burnishers are applied very briskly, and immediately produce a polish which is increased in brilliancy by repeated action. A cloth dipped in a solution of whiting is occasionally used to clean the surface.

The processes we may take next are those of MODELING and MOULDING.*

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* The moulds in general are made of plaster of Paris, which, when properly prepared, has the property of absorbing water so effectually that the moisture is extracted from the clay, and the ware is enabled to leave the mould or "deliver" with ease and rapidity. Prior to use the plaster is put in long troughs, having a

Articles of an ornamental form requiring moulds first come under the province of the modeler. The design being made, the article is modeled in clay, allowance being made for the contraction which the clay, whether porcelain or earthenware, undergoes in the processes of drying and vitrification. And this feature, so peculiar to the business, involves a serious difficulty, and one that is often fatal in its results. For instance, the contraction of earthenware is one-tenth; of china, one-seventh, if pressed; and of earthenware, if cast, one-sixth; and china one-fourth.* The increase of contractility in casting arises from "slip" being used for that purpose instead of clay. In this state it is poured into the moulds, where it remains till a sufficient contraction has taken place to enable it to leave the mould, and also, as a consequence, that it may have acquired a sufficient firmness to support its weight when relieved from it. As the best method of illustration, let us suppose the object to be a figure or group of exquisite symmetry, in which any deviation in the outline or form is, in proportion to the extent to which it occurs, a blemish or a deformity. The figure or group we will assume to be two feet high in the model. The slip has been poured into the moulds of the various parts (sometimes as many as *fifty)* of the subject; the shrinking that occurs before they can be taken out is to the extent of *one inch and a half*, after which they are put together by the "figure-maker," the seams carefully removed, and the whole worked upon to produce the finish of the original model. The group is then dried thoroughly to be in a fit state for "firing;" and here again it suffers a further loss by evaporation of *one inch and a half*, and it is now consequently one foot nine inches. Again, in the "firing" in the bisque oven, its most severe ordeal, it is once more diminished to a greater extent, and is now altogether *six inches* less than the original, or *eighteen inches high*. Now, when it is borne in mind that this contraction should equally affect every part and portion of the object to produce a faultless whole, and also added to this the risks in the ovens of being "over-fired," by which it would be melted in a mass, and of being "short-fired," by which its surface would be imperfect, it must be admitted that very formidable difficulties present themselves; and considering that the finest and most elaborate specimens, whether of figures or ornaments, are the results of this process, it will cease to be a matter of wonder that so many objectionable forms occur, for, however good and pure the design and model may be, there is no protecting influence to save it from these casualties.

We may briefly indicate some particulars in which the Chinese and Japanese are still superior to their European rivals. Their transparent white glaze is generally below the European average, though

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fire running underneath them—by which means the water is driven off, and it remains in a state of soft, fine powder; and if its own proportion of water be again added to it, it will immediately set into a firm, compact body, which is the case when it is mixed to form the mould.

Moulds of fired clay of a peculiarly absorbent texture are also in considerable use, and where they can be introduced are preferred for their increased durability.

* This is the average contraction. There may be a little variation in different manufactories.

specimens are occasionally seen superior to any of the Western productions. In their vitrifiable colors they have a very brilliant black not yet equalled, and a rich purple tinged with crimson which has never been approached in any of our imitations. Chaptal assigns copper as the basis of this color, but appears not to have been able to ascertain the proportions of the composition. The deep green on the Japanese specimens brought to England by way of Java, two of which we have been permitted to examine by the gentleman to whom they belong, are superior to any similar colors produced either in China or Europe; but China again has a superiority in olive-green and in a rich orange, of which some magnificent specimens were to be seen a few years ago in the windows of a shop in Hanway-street.

Lond. Art-Union.

Extract from the Third Report upon the Action of Air and Water, whether fresh or salt, clear or foul, and of various Temperatures, upon Cast Iron, Wrought Iron, and Steel. By* ROBERT MALLET, Mem. Inst. C. E., M. R. I. A.

Conclusions drawn, from discussing the results given in the tables, as regards Iron Ships.

The durability of iron ships has become one of the most important questions involved in the present inquiry, from the rapid extension which this novel branch of naval architecture has received, and is still receiving. Amongst other considerations as to their fitness for distant voyages, and their economic adoption, is that of their durability in respect to corrosion as compared with timber-built vessels, their relative liability to "fouling," and what are the means we possess of preventing or retarding both. If the former, viz: the durability, be ensured, the vessel's remaining clean under water is nearly, if not wholly, attained, for both marine animals and plants adhere with obstinacy to the oxidized iron of a rusty ship's bottom, on which they thrive and multiply, while to clean iron they will scarcely attach themselves.

From the importance of this subject I have been induced to give it a very particular consideration, and propose here to enter somewhat fully into the principal agents of corrosion of iron ships, the directions in which these are found, or may be expected, to act most destructively; to describe the peculiar methods which I have been led to devise for preventing corrosion, also those for preventing the "fouling," which is admitted by the most sanguine advocates of iron ship-building to be at present the salient evil of the system. This matter has acquired increased importance from the recent discovery of Professor Daniell of the existence of sulphuretted hydrogen in the sea water of the tropics, which, our previous experiments show, acts most destructively on iron, as well as on the copper sheathing of timber vessels.

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* Made to the 13th meeting of the British Association for the advancement of Science.

The lower part of an iron ship's floor is exposed to putrid bilge-water(if permitted to accumulate;) this, on grounds already stated, is an agent of great corrosive power, and when heated, as beneath the boilers in steam-vessels, its effects are greatly increased, as far as action from the inside is concerned; therefore the floor and futtocks may be expected soonest to require restoration. This, I am informed, is actually the case in those thin sheet-iron "fly-boats" used for passengers in Scotland and Ireland on the canals.

A remedy for this suggests itself which it would be highly desirable to make trial of, which could be of no inconvenience, and if successful, would have the additional advantage of destroying all smell of bilge-water in a vessel and of preserving her floor at all times sweet.

It has been before remarked that a small quantity of an alkali in solution, even in salt water, is capable of arresting oxidation of iron; it is highly probable that an alkaline earth-lime, for instance, in solution possesses the same power, indeed, Payen's experiments make this certain; there would be no difficulty in keeping lime-water in the place of bilge-water over the floor of an iron ship, to any desirable degree of saturation. The ship's well being periodically pumped out dry, fresh water let in, and a few lumps of dry lime dispersed, a fresh supply of lime-water would be kept up, which would not only preserve the bottom, but destroy the putridity of the bilge-water, of which some will be found even in the stanchest vessel. No injury would be likely to result to the few timbers which would be exposed to its contact.

Exteriorly, the action of air and water will be greatest just between wind and water, and abreast of the paddle-wheels in steamers, where the constant splash from the paddles strikes, and wherever the shell of the vessel is heated by the contact or proximity of the boilers, &c.; but the difference in other parts of the hull is not likely to be considerable unless in very fast-going vessels.

It has long been an opinion amongst those concerned in iron ship-building, that "an iron vessel, when kept in constant use, is not only free from oxidation, but presents no more appearance of corrosion than railway-bars, which (say the advocates of this doctrine) are well known to remain uncorroded so long as the carriages continue to roll over them." "If the iron ship be kept in constant use, *i. e.*, in constant motion through the water, there is no appearance of deterioration; but lay her up for a few months, and the usual appearances of atmospheric action become visible, accompanied by a rapid corrosion of the points exposed." With respect to this singular opinion as to railway bars, we shall have more to say presently; what analogy subsists, however, between a railway bar and an iron ship it is hard to see. I do not doubt the fact that an iron ship kept constantly in motion through the water will present much less *signs* of corrosion than she will do if laid up for an equal time, but the fact does not warrant the conclusion; on the contrary, this fact rightly interpreted is the surest possible proof, and that too from the testimony of those most advantageously circumstanced for judging, that rapid corrosion does take place.

It has been heretofore shown, that when iron oxidates in sea water, the rust, when first formed, is soft and pulverulent; it has also been shown that every metal, iron included, is electro-positive to its own oxides; in other words, that the peroxide of iron formed, acts as an acid towards the iron upon which it lies, in the same way exalting the rate of corrosion as the plumbago formed on cast iron has been shown by the present set of experiments to do upon it.

Now it is admitted than an iron ship at rest does corrode: if so, peroxide of iron is formed if the ship continue long at rest. This coat of oxide gets harder and forms a scale of oxide, which yet more promotes the rate of corrosion; but if the ship be kept in motion, the oxide formed, soft and pulverulent at first, is *swept off* by the passage of her sides through the water nearly as fast as it is formed, and hence, while corrosion is still going on, the exposed surface of iron, when examined, presents a clean and *apparently* uncorroded appearance.

Thus it is not true that an iron ship constantly in motion is incorrodible by sea water; on the contrary, corrosion does go on, and just at whatever rate the conditions of exposure warrant, in a surface of iron whose oxide is removed nearly as fast as it is formed, that is to say, which is exposed only to the corroding effects of the salt or other water, &c., and not to this together with the effect of its own peroxide; but it also follows, from the explanation above given of the phenomena, that the real rate of corrosion of an iron ship is less, and probably a good deal less, while she is kept in motion than while she may be at rest; and for the same reasons her tendency to "foul" is less while in motion than at rest.

By others it has been fancied that magnetism in some occult way interfered with corrosion in iron ships. There is no doubt that every iron ship becomes a magnet by induction from the earth, but the intensity will depend upon the ship's bearing, at any moment, as well as upon other obvious conditions. Admitting, however, that an iron ship were at all times a permanent magnet, no known fact warrants the supposition that its rate of corrosion would be in the slightest degree altered thereby.

The experiments cited by Levol, as apparently leading to a different conclusion, I have since found do not sustain the view of that author. The deficiency in rate of precipitation, &c., observed by him, arose from mechanical impediments introduced by the evolution of gas bubbles, and affected by the different position of his wires in the solution; and had nothing to do with their magnetism.

I therefore look upon it as perfectly certain that iron vessels corrode just as any other mass of iron in similar conditions will. I would add, that no *mere inspection* of surface is sufficient to determine in this case whether oxidation has taken place or to what extent, nor can any sufficiently precise determination of amount of corrosion be obtained by drilling holes through the plates and *measuring* their thickness. This method might give some answer after a quarter of a century's corrosion; but for any moderate period no correct data as to the loss of metal can be had, but by a plate of large size *and known weight*, attached to the ship's hull by rivets or screw-bolts, detached after exposure and *again weighed;* and this experiment has not to my knowledge ever yet been made.

As the hulls of iron ships cannot be ordinarily got at to keep them uniformly covered with any common paint or varnish (which have however alone but a limited palliative effect in preventing corrosion,) such vessels should in all respects be viewed with reference to corrosion, as if the iron was always quite bare; and if so, Table XV., before given, affords data for determining their duration if *wholly unprotected*, but, as we shall see hereafter, iron vessels may be so treated, that in regard to corrosion it is difficult to assign a limit to their durability, which it is generally admitted depends simply on the question of corrosion.

The plates of an iron ship are likely in general to be corroded most round the rivet-heads, both outside and inside, and adjacent to any spots where the plates have been *hardened* by hammering or bending, or in any other way have had their homogeneity destroyed, and least round the bows, &c., where the oxide formed is swept off by the ship's motion through the water.

The contact of oak timber especially, and generally of all timbers which contain tannic or gallic acids, is extremely injurious to iron, and for keelsons, &c., or other timbers in contact with iron and water, teak should always be used in preference, which does not act at all, or but very slightly, upon iron. The bolts and nails of a gate of the fort at Canara, East Indies, after having been exposed to the weather for half a century, were found as sound as when put in: the gate was of teak. In the "Chiffone" frigate certain teak planks had been bolted to her sides; on subsequent removal, the iron was sound and uncorroded in the teak, but eaten through in the oak.

This injurious effect of oak timber as applied to iron ship-building, might however probably be completely obviated by steeping the timber, prior to insertion, in a solution of sulphate of iron, which would engage the whole of the organic acids which act so injuriously upon iron. The oak would become black from the gallate and tannate of iron formed in its pores; its durability would most probably be increased fully as much as by steeping in sulphate of copper, for which, as a mode of preventing dry-rot, a patent has been obtained, and there is no reason to suppose that the timber would suffer any deterioration in toughness, while it would certainly become harder.

Kyanized timber of all sorts is destructive to iron in sea water to a prodigious extent; a portion of the corrosive sublimate (whether more or less changed) contained in the pores of the wood, is decomposed by the contact of the iron, and the quicksilver reduced to the metallic state, which, by its powerful electro-negative relation to iron, promotes the corrosion of the latter. The actual amount of corrosion on best

Staffordshire iron, by my experiments, when in sea water and in contact with kyanized oak, amounted in two years to a depth of 0·122 of an inch of iron removed all over the surface, while the same iron freely exposed to the sea water alone, lost not half so much in the same time. Indeed the utility of kyanizing timber which is to be immersed in sea water appears very dubious, even if it were in this respect harmless; for M. Lassaigne has shown that whatever be the nature of the combination which the corrosive sublimate forms with the albumen of the wood, it is soon washed out, being soluble in salt water; and I have already stated that, in timber freely exposed in sea water, kyanizing is no protection against marine boring animals, kyanized oak being eaten through, two inches thick, in about two years, by the *Limnoria terebrans,* in Kingstown Harbor.

Of course the contact of a metal electro-negative to iron, as lead or copper, with iron ships, either exteriorly or interiorly, should be avoided, and when it is inevitable, increased scantling should be given to the plates, &c., at and around the spot.

The contact also of brass should as much as possible be avoided; but the injurious effects of brass depend much upon the relative proportions of its constituent metals, and by a proper choice in this respect may be made very small. Brass or the alloys of copper and zinc, are to be preferred to gun-metal or those of copper and tin, *all* of which greatly promote the corrosion of iron when in contact with them in a menstruum.

It is a good palliative when copper or brass *must* be in contact with the iron, as in the flanches of sea-cocks, &c. in steam vessels, to interpose a thickness of patent felt, saturated in boiled coal-tar or in wax, or other non-conducting substance; no interposition of "short iron pipes," or other metallic matters, unless masses of zinc, will be of any use; and the effect of local corrosion, thus produced, especially about the engine-room and boilers in iron steamers, demands the most scrupulous caution, much more than appears yet to have been given it, gun-metal sea-cocks, copper blow-off pipes, &c., being at present in general attached directly to the iron hull, which are certain soon to cause the iron plate round them to be eaten away, and thus the vessel is rendered leaky in a vital point and probably at an unexpected moment. The application of a thick zinc flanch outside the ship's side or bottom, at the junction of such a cock or pipe, would be a remedy, but would promote fouling; increased local scantling, and non-conducting flanches between the electro-negative metal and the iron, are most to be commended.

There are several substances found in commerce, the contact of which with the iron of ships, when carried as loose cargo, is more or less injurious, and unless an effective method of protection be adopted, such articles should not be taken in iron vessels but at commensurate freights; some of these may be named, as pyritose wet coal, sulphur, sulphur stone, gypsum, galena, copper ore, or other metallic sulphurets, when wet; alum, salt, bleaching salts; acids of all sorts, when not rendered secure against escape; wet bark for tanning, or other matters containing gallic or tannic acids, &c.

The following extract from our Tables gives the relative values of several of the principal sorts of wrought iron and steel found in commerce, in respect to durability in clear sea water; their relative rates of corrosion are *directly* as the numbers attached to each, and hence the values of the several sorts of iron, &c. for ship-building are *inversely* as those numbers.

Make of Iron.	Inverse Relative Value.
Common Shropshire bar,	36·14
Tilted cast iron,	13·38
Cold short bar, Staffordshire,	13·27
Shear steel, soft,	12·28
Best bar iron, Bradley,	12·05
Spring steel, tempered,	11·81
Blister steel, soft,	11·72
Best bars and plates, Doulais, (hot blast)	10·83
Swedish iron, Dannemora,	10·82
Red short bar, Staffordshire,	10·78
Common plates, Banks,	10·60
Common Shropshire bar, case hardened,	10·14
Best plates and bars, Forest of Dean,	10·08
Cast steel, as hard as possible,	9·38
Best bars and plates, Doulais, (cold blast)	8·85
Low Moor plates,	8·55
Best faggotted scrap iron,	2·52

From the foregoing table, it is obvious that plates rolled from scrapped iron would be the most durable for ship-building; the Low Moor comes next to these; and to these again, the plates from South Wales.

I now proceed to make some observations upon one or two of the methods of protection for iron which have been recently published, before giving the details of that which I have proposed.

The whole of the various methods that have been from time to time proposed for protecting iron from corrosion, may be divided into two classes: those which protect the iron by a mechanical covering, more or less perfect, and itself not acted on by the corroding agent; and those wherein, by the contact of some other body, a change is produced in the electric or chemico-polar condition of the iron with respect to the corroding agents, such that they cease to be so with reference to it.

To the first class belongs the whole tribe of paints and varnishes, and every attempt to cover or *sheathe* the surface of the iron with another metal which is electro-negative to it. The principal methods of this class which have been recently patented, are those of Miles Berry (a communication), for coating iron with alloys of zinc and copper by cementation (May 1838, Newton's Journal, conj. series, vol. xv. p. 91); Neilson's (of Glasgow), for coating iron with brass, by dusting the interior of the mould with brass filings before the metal is poured in &c., a process absolutely useless; and Joseph Shore's, sealed March

1840 (Rep. Arts, No. 84, December 1840), for precipitating copper or nickel on iron by Spencer's electrotype process; and Elkington and Ruolz's process, already spoken of, patented in December 1840, which includes both classes of protection.

To this class also Wall's (of Bermondsey) process, so much brought before the public, may be said to belong, inasmuch as (although, with reference to zinc or copper, this process may produce a change in the chemical relations of those metals to air and water) it has no such effect upon iron, and merely acts upon it as an imperfect but most expensive paint or varnish.

The principle of the second class has been already fully pointed out in preceding Reports, and its conditions experimented on and stated. It has been stated that Sir H. Davy, Edmund Davy, Pepys, and Sorel, long since invented or applied this sort of protection to iron.

The principal inventions dependent upon this method which have been patented, are those by H. W. Crauford (sealed April 1837, Rep. Arts, N. S. vol. ix, p. 289), and Fountainmoreau's (sealed May 1838, Newton's Journal, conj. series, vol. xvi. p. 289). These two patents are in fact one; they are essentially the same, differing only in certain details of application, &c. They both consist in the application of a thin coating of zinc to the whole surface of the iron, by dipping the iron into fluid zinc, when properly cleaned beforehand, or by coating it with a paint, or rubbing it, or lapping it up in a powder of metallic zinc.

Of these various methods not one is completely effective, the causes of which have been already fully discussed throughout these Reports.

The paint made of powdered zinc, and Wall's mercurial paint have no efficacy of an electro-chemical kind whatever towards iron. They differ in no respect from any other paint in being towards *it* mere mechanical coverings, more or less perfect. The result of experiments on the zinc paint have been already given. Wall's patent, which describes an absurd and roundabout process that reminds one of the recipes of the alchymists, and can scarcely be the result of chemical knowledge is, when stripped of its useless encumbrances, simply a mode of making a mixture of several salts of iron and mercury, chiefly sesquichloride and sesquioxide of iron, and subchloride and subnitrate of mercury, with probably suboxide of mercury, which being obtained, the whole is ground into a thin "bodyless" paint with linseed oil; when the paint is long exposed to sea water in contact with zinc or copper, it is *possible* that a small quantity of the mercury may be reduced to the metallic state, and may amalgamate the surface of a *zinc* or *copper* plate in contact with it; but it cannot, under any conceivable circumstances, have the smallest protective power over iron, beyond that which the linseed oil alone gives, the greasy coating of which probably enabled the patentee's prepared plates to resist the acids, &c., applied by those whose testimonials to that effect have been published. In some specimens of zinc and iron which I received prepared according to this process, I found there was not the slightest protection from corrosion when once the greasy film of oil was removed.

I now pass to the second class of methods of protection. Zinc is the only known metal that can be practically used as an electro-chemical protector to iron; it can be applied, in a massive form, locally or at particular centres of action, or it can be diffused in a thin coat of zincing over the whole surface.

There is no considerable difficulty in the first mode of application in most cases, but it is, after the lapse of a greater or less time (generally only a few weeks), nearly useless, from one or both of two causes. Zinc is so slightly electro-positive to iron, that its protective power is nearly destroyed whenever a few spots of red rust have formed anywhere upon the iron it is in contact with; the peroxide acting as an acid towards its own base in both fresh and sea water, the surface of the zinc gets covered in the latter with a hard crystaline coat of hydrated oxide of zinc and of calc-spar, which retards or prevents its further corrosion, and thus permits the iron to corrode. The details of these reactions have been given at length in preceding Reports.

These phenomena also occur when the surface of the iron is all zinced over; but the insurmountable objection to zinced iron is, that in about two years nearly the whole of the thin coat of zinc is oxidized and removed even in fresh water, and in less time in sea water; further, the tendency of zinc to oxidate when fluid and at a high temperature, say 700° Fahr., is so great, and the methods of cleaning the surfaces of iron to be zinced heretofore practised so imperfect, that the surface of iron is never perfectly covered; and whenever an uncovered spot occurs and is exposed to air and water, after a time red oxide is formed, with the results above stated. Zinc, alone or unalloyed, at its fusing temperature, in process of working, gets its oxide mixed up with the metal, which adheres in minute patches to the iron, every one of which becomes the centre of subsequent oxidation.

I will not attempt here to enter upon the theoretical consideration of the process about to be described, but confine myself to a description of the methods to be pursued and the results obtained. These methods of preventing the corrosion of iron, whether cast or wrought, or of steel, are applicable to articles formed of these metals of whatever sort; and the methods of preventing the "fouling" of iron vessels, or vessels sheathed with iron, are appplicable to all articles of these metals immersed in sea or fresh water; I therefore propose their application to all manner of articles of cast iron, wrought iron, or steel; but as by far their most important and valuable application is to the protection of ships built of iron, I will confine my description to the methods of applying my process to such only, from which may be readily understood how it is to be applied to all other articles of iron, &c.

By the word "fouling" as applied to ships, iron buoys, floating beacons, &c., is meant the attachment and adherence to their surfaces, when immersed in sea or certain fresh waters, of various marine or fresh water animals of the molluscous and testaceous classes, and of aquatic plants.

The method of preventing corrosion and "fouling" of iron vessels consists of three principal operations; the first of which is designed to prevent corrosion, the second aids the former, and also prevents the first part of the process being afterwards interfered with by the third operation, which has reference solely to the prevention of "fouling." Hence, for all other articles of iron, except certain of those immersed in sea or fresh water, the first two operations are alone requisite, and in some cases the first only. I proceed to describe in detail the modes of performing the several operations.

The first consists in covering the iron with a particular alloy of zinc in fusion; for this purpose the iron surfaces require to be previously cleansed from adhering oxide. The boiler-plates, angle-iron, &c., to be used for ship building should not be permitted to acquire any red rust previous to the operations about to be described; and if required to lay by for a considerable time previous to use, or to be transported to a distance, should be rubbed over with drying oil or other greasy matter to preserve them temporarily from rust; this oily coating may be afterwards removed by immersion in any alkaline ley.

The plates or other pieces of cast or wrought iron or steel are to be immersed on edge (or in such a position that the detached scale of oxide can readily fall off), in a suitable vessel of wood, pottery, stone, or lead, containing dilute sulphuric acid (specific gravity about 1·30,) or dilute hydrochloric acid, specific gravity about 1·06 at 60°, formed by diluting these acids respectively, as they are usually found in commerce, with rather more than an equal bulk of water.

The diluted acid is best warmed, which may be conveniently done by a steam jacket round the vessel, or by blowing steam into the acid, as it is desirable that the scale of oxide should be detached as rapidly as possible from the surface of the iron. The acid vessel, in operating on the great scale, is best formed so that the lower portion of acid and the scales which have deposited can be occasionally withdrawn, to prevent waste of acid or increased length of time in the cleansing process. The iron must be *wholly immersed*, and the bubbles of gas formed on its surface must be free to ascend in the fluid and escape.

As soon as the scale of oxide has become detached or loosened from the iron, the plates or other pieces are to be removed from the "cleansing bath" and washed with cold water. The surfaces are now to be thoroughly scoured by hand or by power, with sand, or emery, or with pieces of grit stone, while exposed to a small running stream of water, until they appear quite clean, bright, and metallic.

The plates or other articles of iron are now immediately, and without being permitted to dry, immersed in the "preparing bath," in which they are to lie until about to be covered with the alloy of zinc to be hereafter described. The fluid which forms what may be called the "preparing bath" is made in the following way:—To a saturated cold solution of chloride of zinc is to be added an equal bulk of a saturated cold solution of sal-ammoniac, and to the mixed solutions as much more sal-ammoniac in the solid state is to be added as they will dissolve; or these solutions may be made and mixed hot, and the solid sal-ammoniac then added, if thought more desirable, but the addition of more water on cooling is then requisite. The "preparing bath" may also be formed of sulphate of zinc and sulphate of ammonia, or acetate of zinc and acetate of ammonia, or of any other soluble double salt of zinc and ammonia, or salt of manganese and ammonia; the nitrates of zinc and ammonia are the least advantageous, but none answer the purpose so well as the above-described chloride of zinc and sal-ammoniac. No free acid should be present in these solutions.

The iron cleansed by the previous operations, is immersed in this solution, contained in vessels of wood, or pottery, or stone, at common temperatures; as soon as the surfaces of the cleansed iron appear covered all over with minute bubbles of gas, it is in a fit state to be submitted to the final operation of immersing in the metallic alloy with which it is to be coated; but the iron, when once cleansed, may be permitted to remain in the "preparing bath" for any moderate length of time, without injury to the subsequent process. The "preparing bath" becomes therefore a convenient receptacle for depositing and preserving the cleaned or polished iron in until ready for coating with the alloy.

(To be continued.)

Notes on the Hydraulic Ram.

The invention of this singular engine is due entirely to the genius of the celebrated Montgolfier, who made it known in 1797; the peculiar simplicity of its construction, as well as of its mode of action, attracted the attention of hydraulic engineers, and of mathematicians, and in 1804, Eytelwein conducted a series of experiments upon a well digested plan, to develop the power, the proportions, and other relations requisite to its greatest efficiency. The oscillatory motion of the water in the ram, and the alternate action of the valves, indicate the physical causes which produce the effect of this machine; they are nevertheless still very far from being sufficiently understood to furnish the basis of a mathematical theory. The passive resistances, and especially those arising from the shock or blow given by the valves, interpose difficulties in affixing their value, which render any estimate of the *whole dynamic effect* almost impossible. Experiment alone can instruct us as to the *useful* effect it is capable of affording.

D'Aubuisson de Voisins has given a succinct account of the researches of Montgolfier and of Eytelwein, and these notes are chiefly derived from it.

The parts of a ram are, a pipe connecting a reservoir of water with a case or chest, containing two valves—an air chamber, and a rising or supply pipe. The pipe attached to the reservoir was, by Montgolfier, termed the body of the ram, and the valve chest its head. Further description of the construction of the machine and of its mode of action is unnecessary here, as it may be readily found in every modern work on hydraulics.

The largest ram ever erected was put up at Mello, near Clermont sur Oise, by the inventor's son. Its principal dimensions were:

Length of body pipe, . .	108 feet.
Diameter of ditto, ...	4·3 inches.
Weight of ditto, . .	3190 lbs.
Weight of head, . . .	440 lbs.
Contents of air chamber, . .	$1\frac{1}{2}$ gallons.

The tail or stop valve consisted of a horizontal metal plate pierced with seven holes, each covered by a hollow ball $1\frac{1}{2}$ inch diameter; it beats 60 strokes per minute. This ram worked under a head of water of 37 feet, discharging $31\frac{1}{2}$ gallons per minute, and raising 3·85 gallons to a height of 195 feet. The ratio of the useful effect to the laboring force expended was ·653. The comparison of effect is made without taking into account the *velocity* of the motion; it is the weight of water raised to a certain height in a determinate time. Calling p'' this weight, and H″ this height, the effect is $p''H''$.

The corresponding force (P being the weight of fluid furnished by the stream in the same time, and H the height of the fall or head of water,) is expressed by P H.—The ratio of these is consequently $\frac{p''H''}{PH}$, or since $p'' : P :: q : Q$, the ratio is $\frac{qH''}{QH.}$

The following table shows the ratio and the effect of ordinary rams. The first experiment was made upon the ram constructed by Montgolfier himself, at his house at Paris; the second, upon that erected by his son, above cited; and the others, upon rams in the neighborhood of Paris, mentioned in the Traité des Machines, p. 161.

	Height.		Water per minute.		$\frac{qH''}{QH}$	
	Fall. H.	Elevation. H.”	Expenditure. Q.	Delivered *q*.		
1	8′·6″	52′·8	15	1·37	·57	Mean ratio $qH'' : QH = \cdot65$
2	37·2	195·0	31	3·85	·653	
3	34·9	111·11	$18\frac{1}{2}$	3·74	·651	
4	3·3	14·11	4·37	59·18	·629	
5	22·10	196·10	2·86	0·22	·671	
	Ft. In.	Ft. In.	Gallons.	Gallons.		

Eytelwein made, at Berlin, 1123 experiments, gradually and successively varying the dimensions of the several parts of the hydraulic ram. He confirmed the effect produced in each case, and deduced rules for the dimensions and arrangement of the parts, suitable to the greatest effect.

The following table contains some of the experiments upon the largest of the rams he employed, in its most advantageous arrangement, viz:—

Length of body pipe, . . .	43 feet 9 inches.
Diameter of ditto, . .	0 $2\frac{1}{4}$ “
Capacity of air chamber, . .	1·94 gallons.
Area of opening of tail or escape valve,	3·74 square inches.
This area in the first experiment was raised to	6·2 square inches.

The valves were clack valves, and the escape valve was placed between the air chamber and the reservoir. These experiments may have their result expressed by the following formula,

$$\frac{q\,H''}{Q\,H} = 1{\cdot}42 - {\cdot}28\sqrt{\frac{H''}{H}}$$

But as this has been deduced from experiments which in some measure refer to the maximum effect of which the water ram is capable, we may obtain the ordinary results exact enough by reducing the numerical coefficient about $\frac{1}{6}$, and we get

$$p\,H'' = 1{\cdot}2\,P\,(H - {\cdot}2\sqrt{H\,H''}.)$$

See D'Aubuisson p. 503,—also Taffe, Application de la Mechanique, p. 278.

No. of Strokes per minute.	Height in feet of		Ratio.	Gallons of water per minute.		Ratio $\frac{q\,H''}{Q\,H}$.		Ratio.
	Fall. H.	Elevation. H''.	$\frac{H''}{H}$.	Expended. Q.	Raised. q.	Experiment.	Formula.	$\frac{Q}{q}$.
	′ ″	′ ″						
66	10 0	26 4	2·63	10·65	3·39	0·9	0·97	2·92
54	10 2	32 4	3·18	13·97	3·83	0·873	0·92	3·67
50	9 11	38 8	3·9	12·01	2·622	0·85	0·87	4·58
52	8 0	32 4	4·	8·16	1·687	0·847	0·85	4·72
45	8 9	38 8	4·4	10·85	2·09	0·845	0·84	5·2
42	7 5	38 8	5·21	9·92	1·5	0·787	0·78	6·62
36	6 0	38 8	6·5	8·89	1·05	0·754	0·71	8·62
26	4 6½	32 4	7·2	5·23	0·495	0·672	0·67	10·7
31	5 0	38 7	7·7	8·05	0·704	0·667	0·65	11·54
23	4 1	38 8	9·47	11·11	0·649	0·548	0·56	17·2
17	3 0	32 2	10·7	10·8	0·479	0·473	0·51	22·6
15	3 3	38 8	11·9	12·34	0·363	0·352	0·45	33·8
14	2 6	38 8	15·5	11·95	0·22	0·284	0·32	54·6
10	1 11½	38 8	19·3	9·81	0·088	0·181	0·18	106·6

According to Eytelwein, the length of the body pipe ought *not* to be *less* than ¾ of the height to which the water is to be raised. Its diameter in inches, (when Q'' is the number of gallons *expended* per *second)* $= 4\frac{1}{2}\sqrt{Q''}$. The diameter of the rising or delivery pipe should be one-half of this. The air chamber should be as large as the cube content of the rising pipe. The two valves should be close to each other, but it is of little moment whether the escape valve is above or below the air chamber, with regard to the stream of water. The opening of the escape or tail valve should not be less than the section of the body of the ram.

Example.—Let it be required to raise 220 gallons of water per hour to a height of 46 feet; the disposable head of water being 4 feet; to determine the expenditure of water per second, and the principal dimensions of the ram—

220 gallons per hour = 2200 lbs. = 36·6 lbs. per minute;

$$36{\cdot}6 \times 46 = 1{\cdot}2\,P\,(4 - {\cdot}2\sqrt{46 \times 4.})$$

$$\text{or } P = \frac{36{\cdot}6 \times 46}{1{\cdot}2\,(4 - {\cdot}2\sqrt{184})} = \frac{1403}{1{\cdot}29} = 1087{\cdot}6 \text{ lbs. per minute ;}$$

and 108 76 gallons per minute = 1·81 gallons per second.

Diameter of body pipe $= 4\frac{1}{2}\sqrt{1{\cdot}81} = 4\frac{1}{2} \times 1{\cdot}346 = 6$ inches, nearly.

Length of ditto should not be less than 44 feet,—say 50 feet.

Diameter of rising pipe $= \frac{6}{2} = 3$ inches.

Content of ditto $= \dfrac{3^2 \times {\cdot}7854 \times 46}{144} = 2\frac{1}{4}$ cube feet = capacity of air chamber.

Diameter of opening for escape valve = 6 inches.

If ball valves are used, their weight should be twice that of the corresponding bulk of water.

D'Aubuisson, p. 504, makes the following important remarks:—"The hydraulic ram has only been employed hitherto, in raising small quantities of water, and, therefore, in producing small effects. The greatest effect obtained by Eytelwein from 1123 experiments was only 1476 lbs., raised one foot in a minute ; and the greatest from the rams used in France is but 7500 to 8500 lbs., raised one foot in a minute, or about one half the work done by a horse, harnessed in a gin."

It is very doubtful whether the ram can be used for raising large volumes of water. The violent shock of the valves, and the heavy pulsations of the machine, derange the frame and the foundations made to support it. This it has been attempted to obviate by materially increasing the weight of the ram, and in this way the loss of effect arising from the movement of the machine may be diminished, and the evil remedied up to a certain point.

The strong frame-work and heavy masonry constructed to support large rams, have been entirely destroyed after a certain length of time; and it is much to be feared, that the employment of this engine, in other respects so remarkable, will continue to be restricted, and that its sphere of usefulness will not extend beyond the supply of water to an isolated house or manufactory.

1, *Lancaster-place, Nov.* 5, 1846. J. H.

Civil Eng. and Arch. Journal.

Self-Registering Instruments.

Mr. Brooke stated that he had applied to the barometer, thermometer, and psychrometer, a new apparatus, by which also he had obtained a register of variations of the declination magnet, a description of which he had transmitted to the Royal Society. This may be briefly explained to consist of two concentric glass cylinders, which enclose between them a piece of photographic paper, and are carried round by clockwork once in twelve hours. These are covered by a blackened case having a narrow slit parallel to the axis of the cylinders, through which a small point of light, reflected from a spherical concave mirror attached to the magnet, and then refracted through a cylindrical lens, passes and impresses the paper. Some photographs were exhibited, and were much approved of by the President, by Dr. Whewell, and other leading members of the committee who were present: from these the position of the magnet at any given time might generally be determined within ten seconds, and frequently within five. The self-registering barometer was described as a syphon barometer, the extremities of which were nearly an inch in diameter, and exactly the same size, being adjacent portions of the same tube. A glass bulb having a tubular stem rests on the surface of the mercury in the lower end of the tube, and is maintained in a vertical position by small friction-rollers. On this stem rests the short arm of a balanced lever, and the barometer is so placed that the long arm of the lever carries a black paper screen between a lamp and the slit in the apparatus above described; the light of the lamp being condensed by a cylindrical lens placed in front of and paralled to the slit in the apparatus. This screen has a narrow slit in it, at right angles to the former; and the small portion of light, transmitted through the point at which the two slits cross each other, produces a trace upon the photographic paper. The ratio of the arms of the lever may be determined at pleasure, so as to magnify the variations from two to ten times; and as the line is very sharply defined, when magnified five times, the variations may be readily determined to the thousandth part of an inch. The author stated that he had not had the opportunity of determining the errors of the instrument, arising from friction and other causes, but he believed them to be very small. In the self-registering thermometer and psychrometer the mercury in a wide flat bore of the tube, intercepts a portion of the focal line of light formed by refraction through a cylindrical lens placed as above. This does not require more particular description, as it differs only in details from similar apparatus, of which a description is in print.

Mr. F. Ronalds, on presenting his third annual volume of observations and experiments made at the Kew Observatory, described his experiments on the photographic self-registration of the electrometer, the barometer, the thermometer, and the declination magnetometer, explained his existing apparatus for these purposes, and exhibited the resulting photographs—but first briefly adverted to his previous proposals in 1840 and 1841, and experiments in 1844, relative to the subject. The principal characteristic of his improved system is a peculiar adaptation of the lucernal microscope. An instrument of this kind was employed in July 1845 to register the variations of Volta's atmospheric electrometer. The pair of straws were properly insulated and suspended within the body of the microscope, and towards its object end. A condensing lens was placed at the end itself, and a good lamp stood beyond it; a strong light was therefore projected upon those sides of the straws which were turned towards the condensing lens, and the other sides were in deep shade. The light also impinged upon a little screen fitted into the back of a case about two feet long fixed to the eye end of the microscope, at right angles with it, and vertically; through this screen was cut a very narrow curved slit, whose chord was horizontal, and radius equal to the length of the straws. Between the electrometer and the screen an excellent combination of schrometer lenses by Ross was accurately adjusted, to produce a good chemical focus of the electrometer, at a distance as much beyond the external surface of the screen as the thickness of one of the plates of glass to be presently mentioned. In the long vertical case was suspended a frame about half the length of the case, provided with a rabbet, into which two pieces of plate glass could be dropped, and these brought into close contact by means of six little bolts and nuts. The frame could be removed at pleasure from the line by which it was suspended, and the line, after passing through a small hole stopped with grease at the top of the long case, was attached to a pulley about four inches in diameter, on the hour arbor of a clock. Lastly, counterpoises, rollers, and springs were used for insuring accurate sliding of the frame, &c. A piece of photographic paper was now placed between the two plates of glass in the movable frame, the long case was closed so as to prevent the possibility of daylight entering it, the clock was started, and the time of starting was noted. All that part of the paper which was made to pass over the slit in the screen by the motion of the clock, became now therefore successively exposed to a strong light, and was consequently brought into a state which fitted it to receive a dark color on being again washed with the usual solution, excepting those small portions upon which dark images of the lower parts of the straws were projected through the slit; these parts of course restrained the light color, and formed long curved lines or bands, whose distances from each other at any given part of the photograph, *i. e.* at any given time, indicated the electric tension of that time. Sometimes daylight was used, instead of the light from a lamp, and in that case, during the process some appearances of the sky were occasionally noted, by which it was evident that in serene weather, when the sun's light and heat varied, and the paper became consequently either more or less darkened, the electric tension as shown in the photograph varied also, increasing with the increase of light, &c. This fact has not perhaps before been observed; but as the darkening effect on the paper could not always be depended upon, separate notes were taken of the intensities of light and the same results obtained. At the suggestion of the astronomer royal, a distinguishing electrometer, formed on the day pile system was afterwards employed, which exhibited in the photograph not only the tension but the kind of electricity possessed by the electrometer at any given time.

The *dry thermometer* was next tried; it was of the horizontal kind, had a flat bore, and its tube was introduced through the side of the microscope; the tube had a diaphragm of very narrow aperture fixed upon it, and the slit in the screen at the eye end of the microscope was now of course straight and horizontal. The image was a little magnified, and the breadth of the dark band or line in the photograph became the measure of temperature inversely at any time.* The barometer employed was of the syphon kind; the microscope was turned, in order to bring the long case and its sliding frame into an horizontal position; the clock was placed at one end, and a little weight sufficient to keep the frame steady was suspended by a line over a pulley at the other end. The lower leg of the barometer was introduced through the new bottom of the microscope, it was provided with a similar kind of diaphragm to that on the thermometer, and of course the slit in the screen was now vertical. A very light blackened pith-ball rested on the surface of the mercury, and its image was slightly magnified, but will in future be much more so. The *declination magnet* was one of two feet, provided with a damper, and its mode of suspension was essentially similar to that of the Greenwich declinometer. In order to adapt it for self-registration, a very light conical brass tube, projecting six inches beyond its north end, was affixed to the lower side of the spur which carried it, and to the north end of that tube a small wire, called the index, was attached at right angles; this index descended through little slits in the bottoms of the two cases, enclosed the maguet, &c., and took the place of the electrometer described above in the lucernal microscope, which was placed below the cases, and was now required to be much longer than before, in order that the image and motion might be sufficiently magnified, yet etaining a flat field. Everything was very firmly fixed upon the two pillars which formerly carried the transit instrument of George III.

A great many photographs were obtained and sent for inspection to Greenwich. Of some termday impressions, Mr. Glaisher, the magnetical and meteorological superintendent of the Greenwich Observatory, says, in an official note, that "the beautiful agreement of these results with those at Greenwich is highly satisfactory." This must be gratifying to Mr. Ronalds, who has from the first so ably devised and conducted the experiments and observations at Kew.—*Transac. Brit. Assoc.*

Ibid.

On the Corrosion of Iron Rails In and Out of Use. By R. MALLET.

The researches on this subject are still in progress, experiments are being made upon six different lines of Railway. The principal facts already ascertained are;—1st. That there is a real difference in the rate of corrosion between the rails in use and out of use:—that this appears to be connected with their peculiar molecular condition so induced. 2nd. The determination of the complex conditions as to magnetism, which affect rails some time in use, producing both induced and permanent magnetism in the rails, each rail being magnetic with polarity, and having from four to eight separate poles each.

Mr. Hunt stated his confirmation of the experiments of Ritter—that magnetism had the power of protecting iron from corrosion;—to which he referred the protecting influence exerted on the rails in use on railways. ib.

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* In order to convert this into the wet-bulb 'hygrometer,' nothing of course is necessary but the application of the usual cup of water and the capillary threads.

Notice of a Gas Furnace for Organic Analysis. By Dr. Percy.

This was an ingenious arrangement, by which gas burnt, mixed with air, through wire gauze, was substituted for charcoal. Its advantages are its extreme cleanliness, and the power which the operator possesses of regulating, at will, the heat,—which is not practicable in the ordinary furnace for organic analysis with charcoal. ib.

On the Sailing Powers of two Yachts, Built on the Wave Principle. By Dr. Phipps.

The first was built for Dr. Corrigan, of Dublin, in 1844; a small open boat 24 feet by 6, of 3¾ tons, which did so well that she was able to beat everything near her own size, and to sail with those which exceeded it in some instances as far as four times. She was dry on seas where they were wet, was very stiff, sure in stays, and steered well at all times. The second is a yacht of 45 tons, O.M., for Samuel Holder, Esq., of Ringabella; built from the drawing by Mr. Peasely, of Passage West, in Cork. She appears to have the following qualities: a first rate performance, attained without sacrifice of any good quality, large accommodation, high stability. She is weatherly, steady, and easy, dry in the worst weather, and pitches and ascends less than any vessel I was ever in. She turns so sharply that no ten ton yacht can do it quicker, and steers so well, scudding in a gale of wind, that notwithstanding an unbalanced state, from an injudicious shift of mast, she neither broaches to, nor is compelled to lay to—which a companion of larger size (60 tons), and of tried sea qualities, was forced to do, and, in consequence, arrived from Cork to Dublin 14 hours after the wave-built yacht. In a race at Kingstown for the Railway Cup of 100 guineas, in which she was matched against the best boats of the three countries, in a time race, including one fine yacht of 100 tons, she won—and did the course exactly in 4h. 22m. 58s.—it being 46 nautic miles. Making no allowance for tacking or starting from absolute rest, the rate of this is 10½ knots per hour. This is a great result for a principle yet in its infancy. The same vessel left Holyhead in a gale of wind, with storm-sails, main sail stowed, and everything made snug; with a reefed try-sail, a double-reefed foresail, and third jib. She lay in one stretch to the Irish coast, where she tacked to the southward, beating down to the Arklow light in 11 hours. Six persons on board, being separately questioned, agreed that the time from Holyhead to the Irish coast was 4½ hours. Making every reasonable allowance, less than 50 nautic miles could not have been done; and this gives a velocity of 11 nautic miles per hour,—an unrecorded speed for ships of any size, close hauled, but surprising for a vessel of 45 tons, and in a very rough sea. It was, in fact, remarked on board that, as the wind freshened, her pace increased without limit. This agrees with the fact stated by Capt. Fishbourne, of the Flambeau steamer, on wave lines, that she had a speed greatest in the worst weather, as compared with her rival.—It is perhaps possible to improve sailing vessels greatly, as compared with steamers. When so improved, they might be used where sailing vessels nearly compete with steamers at present. This may be further helped by the diminution of insurance and of the present unnecessary waste of human life.

Mr. Scott Russel, after expressing his gratitude to the Association for directing its attention to so important a subject, proceeded to explain the theory of what was known as the wave principle in ship building. He was first induced to direct his attention to this subject when the canal companies proposed some years ago to establish swift boats that might compete with the mail coaches. On being applied to by them, his first attempt was to build one with a spheroidal bow, produced by the revolution of an ellipse; but the result was not as successful as was to be wished. The favorite shape of bow among seamen at the time was that called a duck's breast, but the effect was to raise a large wave immediately in front of the vessel, which of course considerably retarded its velocity. He then directed his attention to the motion of the water itself. When a vessel passed through the water at a great velocity a high wave was raised at the head, as high in the old steamers as four feet; and this wave on falling back formed a hollow by its pressure immediately behind it, and the water was afterwards sent out with great force on both sides of the bow. All this was a costly and useless expenditure of force. He thought that, in removing the particles of water to allow the vessel to pass, it was necessary to expend the least force on the whole; and, therefore, the first impulse should be given gently. This force should increase to a certain point, and then decrease as gradually, leaving the particles to rest quietly at the greatest breadth. In endeavoring to ascertain the least resistance necessary to bring the particles of water out of a state of rest he conceived that there ought to be a similarity between the motion of water and that of a pendulum revolving in a circle according to the curve of the vessel's size; and this led him to adopt the form known as the wave principle. This is different from a bow formed of two straight lines meeting at an acute angle; it being gently hollower than such a bow towards the cutwater, and a little rounder towards the greater breadth. The object to be attained was, he conceived, to remove the particles of water rapidly, and at the same time not to throw them farther aside than the breadth of the vessel amidships. That this object was effected by the wave principle he ascertained in the following manner:—He got his model boat, 75 feet long, to be carried along by high-bred horses at a speed of 17 miles an hour, and made the head pass between two oranges floating on the water, and which he intended to represent two particles of the water to be removed. The oranges merely touched the side of the vessel until they got amidships, and there remained; thus showing that no greater force had been applied to them than was necessary to remove them out of the way of the vessel. Another phenomenon observed was, that, instead of the high wave at the bow, which sailors thought was a sign of a ship sailing well, or what they called carrying a bone in her teeth, the elevation and subsequent depression of the water were entirely got rid of. In their place there was a gentle, long elevation, just under the shoulder of the vessel,where all sailors would like her to be supported. For the closing of the water at the stern he at first thought it would be better to have the same shape behind ; and this had the effect of bringing the oranges together again behind in an horizontal direction ; but he found it did not answer at all. It occasioned too high a resistance, and had a multitude of bad qualities. He discovered, in fact, that the fuller she was behind, and the flatter she lay upon the surface of the water, the quicker she sailed ; and that this should be the case is clear, when it is considered that the water, returning to its level, is governed by an entirely different law from that by which it is first separated. The power which sends the water into the wake has nothing to do with that which displaces it before. It is forced upwards by the greatest pressure from below in vertical lines of the cycloidal family. A run fine below and full above was attained, by many experiments, as the best for good steering and other qualities. This full water-line above should never exceed a cycloid. The vertical lines, in which the water rises in the secondary wave (which really replaces the displaced water) may be cut off, at any convenient height, close to the stern. These two considerations united led him to the adoption of what is known as the wave principle. In the wave formation the greatest breadth of the ship is not at the bows, or even amidships, but a great way aft, in the ratio of three to two. In the shear plan the bow of this form has one main cycloid, and all the other bow lines are parts of cycloids. In this form the particles ascend and descend without shock.

Mr. Vignolles asked if the Admiralty had got vessels built on this principle,—*and if not, why not!*

Mr. Scott Russel replied, that he had been much more desirous for the adoption of the system in other ships than in the Admiralty, because he had been informed that the Admiralty did not like the introduction of scientific principles into ship-building, and preferred remaining as they were. He had, therefore, been averse to obtrude the subject on them. He might state, however, that the best informed men, at the Admiralty, were aware of the existence of the wave principle ; and it was not improbable they might adopt it, though he could not say how soon, nor to what extent. Ib.

Account and Description of Chemitype Printing.

Those who are aware of the deficiencies still existing in the practice of wood-engraving will gladly receive the intelligence of a newly invented art, which, though unlikely to supersede wood-engraving altogether, may certainly remedy the imperfections to which it is subject. This art is termed Chemitype Printing. It has been invented by Herr Pül, of Copenhagen, and practised by him at Leipzic, in conjunction with G. H. Friedlein, graphic printer, of the same city. By this method an etching or engraving, made on metal in the usual way, may be converted into a high relievo stamp, to be used for printing on an ordinary printing press, as is the case with common wood-engravings. The following statement may in general illustrate the character of the invention :—Zinc, being the most positive of all metals, and, at the same time, the cheapest, is principally used. On a highly polished plate of pure zinc an etching or engraving is made in the usual manner, which, under common circumstances, would be fitted for impressions on a copper engraver's press, having the same harmony and proportion of all the respective etched or engraved lines. The tracery, thus deepened, is now to be fused or melted down with a negative metal, and the original metal plate (zinc) corroded or etched by means of a certain acid, thus making the cavities of the former drawing appear in the shape of a high relievo stamp. This effect is only produced in consequence of the metal composition in the lines of the tracery not being acted upon by the acid on account of the galvanic agency subsisting between the two metals, and the acid corroding only the zinc, according to the discoveries of the celebrated Professor Jacobi.

After these details there cannot be the least doubt of the specific difference between chemitype printing and glyphography, relievo etching in copper, and other similar artistical processes and practices lately invented. Its principle rests upon the positive and negative nature of the metals. As every drawing on the metal plate is completely exact in the relievo stamp, the practice is absolutely independent : the exact and accurate representation of the original sketch is always to be expected. Wood-engraving can, in most cases, be superseded by this novel method ; but whenever little outlay and a necessity of putting the impressions continuously in the letter-press are to be considered, much better work can be furnished by chemitypes. In many other instances the new practice is preferable, chiefly when colored printing is required, *e. g.*, in the representation of maps, plans, architectural drawings, &c., &c. At the same time, the correction or improvement of any drawing can be much better executed than in wood-engraving.

Herr Pül has published a pamphlet on his valuable invention. It is accompanied with some excellent specimens, which, even at first sight, give a decided testimony to the superiority over wood-engravings. Every new addition to the facilitated means of all sorts of Art, by which they may become the multiplying agents of general civilization, must be received with consideration.*

London Art-Union.

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* We have seen some specimens of the printing referred to by our correspondent, which are undoubtedly superior to ordinary wood-engravings; but our readers must be aware we cannot form an accurate opinion of the true value of the invention from the two or three examples sent us for inspection.

Experiments on Tanned Canvas for the use of Artists.

In this paper the writer states the processes and results of certain experiments which he instituted with a view to ascertain the antiseptic property of tan applied as a preservative to artists' canvas. The experiment was made upon two unpressed three-quarter canvases, which, having been steeped in tan prepared for the purpose, were hung in a very damp cellar, together with two other canvases which had not been so prepared. After the lapse of ten years the tanned canvases were found to be as perfect as when first put into the cellar, while the untanned exhibited signs of decay. The canvases were replaced in the cellar, and during ten years more subjected to the same trial, after which the untanned canvases dropped from the frame, while the other remained perfectly sound. We all know with what success our fishermen tan their nets and sails, to preserve them against the destructive effects of the salt water; but these experiments of Mr. Millett are nevertheless highly valuable. Ibid.

Improvements in Concentration of Sulphuric Acid.

From the inconvenience which has long been experienced in the ordinary process of concentrating sulphuric acid in glass vessels, from the frequent breaking of the glass, and the great care required to keep the hot vessels from draughts of cold air, Mr. Jones, chemist, of Bristol, has obtained a patent for enclosing them in what he terms a protector, made of sheet-iron, tin, or other suitable material, not liable to be injured by the heat of the process: it may be cylindrical, square, or any other figure, provided it completely envelops the glass vessel; it should be 5 in. or 6 in. larger in diameter, so as to inclose the glass in an atmosphere of hot air during the operation. By this means the process will be shortened, a considerable saving in fuel and labor be the result, and the glass vessels last much longer. Min. Jour.

Letter from Professor Hare, on the use of Hydrogen for Gas Lighting.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Gentlemen,—I beg leave to refer you to a communication of mine in Silliman's Journal, vol. ii, for 1822, page 172, where you will find that I stated that I had rendered hydrogen sufficiently luminous to act as a gas light, by presenting to it, in a nascent state, oil of turpentine.

I make this reclamation in consequence of the article in the last number of the Journal of the Franklin Institute, representing an analogous process as the invention of a Mr. Jobard.

I am yours, with regard, ROBERT HARE.

January 14th, 1847.

JOURNAL
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OF THE
State of Pennsylvania,
AND
AMERICAN REPERTORY.

MARCH, 1847.

CIVIL ENGINEERING.

Annual Report of the Canal Commissioners of Pennsylvania, transmitted to the Governor in pursuance of Law, for the Financial Year ending November 30*th*, 1846.

The following report of the operations upon the canals and railroads of the commonwealth, is respectfully presented by the Canal Commissioners of Pennsylvania, embracing the fiscal year commencing December 1, 1845, and ending November 30, 1846.

The receipts and expenditures upon the public works, during the fiscal year, have been as follows:—

Receipts.

For motive power charges and for use of State trucks on the Philadelphia and Columbia railway, including fines, and for old materials sold,	$ 250,757·90	
For motive power charges and for use of State trucks on the Allegheny Portage railway, including fines, and for old materials sold,	140,639·75	
For tolls on the Philadelphia and Columbia railway,	223,792·73	
For tolls on the Allegheny Portage railroad,	46,038·04	
		$ 661,228·42

Amount brought forward, . . .		$ 661,228·42
For tolls on the main line of canal, including collections at out-let locks, bridges, and aqueducts; also rents, fines, and old materials sold,	335,809·56	
For tolls, rents, fines, &c., on the Delaware division,	146,321·56	
For tolls, rents, fines, &c., on the Susquehanna, and North and West Branch divisions,	152,135·22	
		634,266·34
Total gross receipts,		$ 1,295,494·76
Expenditures.		
For maintaining motive power on the Philadelphia and Columbia railway, including the repair and management of State trucks,	$ 157,846·23	
For maintaining motive power on the Allegheny Portage railway, including repair and management of State trucks,	103,260·62	
For repairs on the Philadelphia and Columbia railway,	58,702·24	
For repairs on the Allegheny Portage railway,	25,567·45	
For repairs on the main line of canal,	140,855·92	
For repairs on the Delaware division,	43,554·53	
For repairs on the Susquehanna, and North and West Branch divisions,	115,063·64	
For compensation of collectors, weighmasters, inspectors of cargoes, including house rent, stationery, and incidental expenses of their offices,	32,073·68	
For compensation of lock-keepers,	33,006·60	
		709,930·91
Receipts over expenditures,		$ 585,563·85

From the above sum of $585,563·85 may be deducted $5,041·72, the amount expended for pay of Canal Commissioners, secretary, clerk hire, messenger, stationery, postage, and incidental expenses of their office, leaving $580,522·13 as the net revenue produced by the canals and railroads of the commonwealth, for the year ending November 30, 1846.

The foregoing synopsis of receipts and expenditures, embraces the cost of maintaining the motive power on the Philadelphia and Columbia, and Allegheny Portage railroads; the cost of repair, ordinary and extraordinary, upon the canals and railroads of the State, as also the compensation of all the officers and agents employed on them during the year; the payments for work and labor done at the Eastern reservoir. The sums paid for damages, under general and special acts of Assembly, and the balance of a former appropriation for the purchase of new trucks, which was expended for that object, are not embraced in the foregoing statement of receipts and expenditures for the year 1846, as they are not considered as belonging to the repairs and management of the public works for any *one* fiscal year, but are brought into view in another part of this report.

It may be proper to state here, that on comparing the foregoing statement with the actual receipts from, and payments to, internal improvements, as given in the report of the State Treasurer, for the fiscal year ending on the 30th November, 1846, a considerable variance may appear, which is readily accounted for by the fact that the transactions of the officers, (residing in parts of the State remote from the seat of government,) at the Treasury, cannot be brought up to the last day of the fiscal year, on which the balances are all struck at that department; consequently, in the statement of the Treasurer, a portion of the receipts, which properly belong to the past year, but which, although collected in that year, were not paid in, nor credited until after the 30th day of November, will appear as receipts of the fiscal year ending on the 30th day of November, 1846. The same may be said of a portion of the receipts of the year just closed, which will be carried in this way to the ensuing year. The payments at the Treasury are also charged, as of the date on which the disbursing officer draws the money, to be thereafter paid out and accounted for by him, and do not, therefore, show the exact transactions in the way of expenditures within the year. The Canal Commissioners, however, in the foregoing statement, have not omitted any thing actually expended during the fiscal year, whether paid and settled before the close of the year or not. Nor have they included any thing in the receipts which did not come into the hands of the collecting officers during the same period.

In their report of last year, the Canal Commissioners estimated the gross receipts, for the year just closed, at one million two hundred and seventy-five thousand dollars, and in this respect their anticipations have been more than realized; but they regret to state, that the freshet of March last, (unprecedented within the last sixty years,) sweeping, as it did, entirely over a great portion of our canals, and carrying upon the surface of the water immense masses of heavy ice, produced the necessity of very heavy expenditures for extraordinary repairs, as well as much detention in the opening of navigation upon the several lines of canal. In the tabular statement attached to this report, numbered *one*, the character and cost of the repairs are stated, distinguishing between those of an ordinary character, and those rendered necessary by floods and other casualties.

The operations on the public works, with suggestions in reference to them for the ensuing year, will be noticed in order, commencing with the Main Line.

Philadelphia and Columbia Railway.

From the report of the superintendent of this work, it will be perceived that the operations in the motive power department have been conducted with much regularity and despatch, and that no casualty of a serious character has occurred.

The reduced expenditure, in proportion to the amount of tonnage, number of cars, and passengers transported over the road, is a gratifying evidence of the skill and integrity of the officer who has been charged with its management during the three last years.

The machinery upon the road is represented by the superintendent in excellent condition; extensive rebuilding and repairing of the engines having been done during the past season. The power of the stationary engine, at the head of the Schuylkill inclined plane, has been increased by the substitution of new and enlarged boilers for the old ones, which were worn out, and other important improvements. The repairs upon the road have been more than ordinarily expensive during the past season, owing to the rapid wear of the rails, and the heavy burthens carried over it. It has been found necessary to insert *forty tons* of new rail, which cost, at the works at Danville, *eighty dollars* per ton. When it was ascertained by the Board that this price was demanded for the new rails, they would have deferred ordering them at the time, indulging the hope that they might be subsequently obtained at a lower rate; but the condition of the road, and the absolute necessity of immediately supplying the place of old rails with new ones, on many parts of it, to maintain it in order for transporting freight and passengers safely, left the Board no alternative but to direct the superintendent to make the purchase at what they considered an extravagant price.

As the condition of the road is such as to require a considerable quantity of new rail every succeeding year, it is suggested that means should be placed at the disposal of the Board, so that contracts for iron may be made some time in advance of the period when it becomes necessary to use it, and the commonwealth be saved the necessity of paying more than this article should cost, in an emergency such as has been noticed.

That part of the railway between White Hall Station (eleven miles from Philadelphia,) and Columbia, is generally in reasonably good condition. From the head of the Schuylkill inclined plane to White Hall station, the whole travel and tonnage has, for several years, passed upon a single track, and it is, consequently, difficult and expensive to keep in repair. It will be remembered that the superintendent, in his report last year, submitted an estimate for an additional track upon this portion of the road, amounting to fifty-eight thousand dollars, and the Board concurred in recommending the measure to the attention of the Legislature. In his report of this year, the same officer has submitted an estimate for the same object, amounting to sixty-three thousand three hundred and ninety-five dollars; the difference between the former and present estimate, being made up in the increased price of iron now demanded over what it could have been purchased for in 1845.

In reference to this subject, the following extract from the report of the superintendent is respectfully commended to the attention of the Legislature, as containing the views of the Board, viz:—"It is certainly a source of regret that an appropriation was not made last winter towards an object of so much importance, as the situation of the South track is now such as renders the renewal of a portion of it imperative." It is hoped that the Legislature will no longer postpone (by withholding the necessary appropriation) the commencement of a work which is becoming indispensable from the increasing business upon this great thoroughfare. In the estimate submitted for the repair of the Philadelphia and Columbia railway for the year 1847, it will be seen that the sum required for that object is considerably larger than the amount expended during any one of the three preceding years; this results from the necessity of procuring and inserting new rails, and extensive repairs being indispensably required at the Coatesville viaduct and other mechanical structures. For more minute details of the operations upon this road, as also for the different items of estimated repairs, the Board respectfully refer to the report of the superintendent upon the road.

Allegheny Portage Railroad.

This link in the main line of the State improvements was opened for use about the middle of March, and the business regularly conducted upon it throughout the season, with such interruptions only as resulted from a scarcity of trucks, at times, for all the section boats offering, and such as were caused by extraordinary floods and land slides upon the road. The locomotives and machinery are represented as in good condition, with the exception of such of the stationary engines as will require their foundations rebuilt during the ensuing winter. These repairs to the foundations are necessary, as well to conduct the business safely by the use of hemp ropes, (as has been the case heretofore,) but are essentially so, in order to adapt the machinery to the use of wire ropes, which are now found to be manifestly superior in point of safety and economy to any heretofore used.

In proportion to the tonnage passed upon this road, the expenses of maintaining the motive power have been less for the year 1846, than at any former period.

These expenses, it is confidently believed, may be still further reduced by substituting locomotives on most of the levels where horse power has heretofore been used, and by the employment of wire ropes upon all the planes. These improvements have been directed to be made, and in order to supply the motive power, it is designed to remove from the Philadelphia and Columbia railway to the Allegheny portage railway, such of the locomotives as can be spared from the former, when *two* new ones, which the superintendent of that road has been instructed to contract for, have been delivered.

From the report of the superintendent of motive power, it will be seen that an additional number of trucks will be required for the business of next year, to accommodate and pass without detention the section boats that navigate the main line. This system of transportation is found from experience to be very severe on the railways, wearing out and crushing the rail ends, as well as deranging the track to a much greater extent than the use of ordinary cars.

The Board would respectfully leave to the Legislature the decision of the question, whether, under all the circumstances, this mode of transportation should be further encouraged, and the facilities increased beyond the provision already made for it by the commonwealth.

The cost of repairs on the Allegheny Portage railway during the past year, although less than that of the preceding year, has been considerably enhanced by the increased business upon it, and the remarkably heavy rains which occurred several times during the season. The superintendent states that *three* several times the operations upon the road were for a time entirely suspended in consequence of the hill sides giving way at different points, and large bodies of earth and stone covering the track, and in some instances carrying with it the whole road at these points. The frequent heavy rains have done considerable damage by filling up the ditches and culverts, besides causing the streams in the vicinity of the road to pass over it in several places and sweep out the whole embankment, road bed, blocks, &c. All these injuries were promptly and permanently repaired with the least possible delay practicable under the circumstances. The condition of the tracks upon the inclined planes has become such from the decay of the wooden superstructure and the wear of the flat rails, that the time has arrived when a commencement must be made to relay them with T rails. To postpone any longer this improvement, is to embarrass and retard transportation over the road, and at the same time incur more risk of accidents, as well as increased expenditures for the motive power.

To enter into detail in reference to this work, would swell this report beyond reasonable limits, and the Canal Commissioners therefore respectfully refer for more minute information to the accompanying report of the superintendent of the road.

Main Line of Canal.

The main line, it was designed by the Board should be ready for navigation by the 17th of March last, and the ordinary repairs had been made during the preceding winter with the view of opening it at that time; but that intention was frustrated by the unprecedented flood which has been hereinbefore alluded to, and which delayed the opening of the navigation until near the middle of April. After the opening of the navigation some slight interruptions to it occurred, occasioned by breaches at various points on the line, and lastly by a high flood in the Juniata river near the close of the season.

The nature and extent of the damage to the main line, as also that sustained on the other divisions by the great spring flood, was, immediately after its occurrence, communicated to both branches of the Legislature in a special report from the Board, and it has not been deemed necessary to recapitulate it on the present occasion.

In addition to the ordinary repairs required in clearing out the canal, repairing and strengthening the banks, &c., much of an extraordinary character, such as rebuilding of the mechanical structures, has been required during the past season, among the heaviest of which may be enumerated—two new aqueducts, rebuilding one lock and making water way and feeder around the guard lock at the Clark's Ferry dam, all on the Eastern division.

Clark's Ferry Bridge.

This important structure was seriously injured by the flood in March last, before referred to—two of the piers having been partially cut down by the heavy floating ice, and two spans, or about one-fifth part of the superstructure, carried away, besides considerable injury to the arch timbers of the other spans. The officer in charge of the line had been instructed, and was making arrangements to rebuild and repair the injured portion of this work, but before any considerable amount of work had been done to it, the remaining portion of the superstructure unfortunately caught fire from sparks blown upon it from the engine on the boat engaged in towing the canal boats across the pool of the dam. After this disaster, the board were strongly inclined to adopt the wire suspension plan in the reconstruction of this bridge, but upon inquiry they ascertained that the cost would be so much beyond that of a good wooden superstructure, that under all the circumstances, and in view of the means at their command, they concluded to rebuild it of wood upon the arch and truss plan, modifying, and, as they believe, improving on the plan of the old superstructure. At the same time, they deemed it prudent to raise the whole work three feet above the original height, to secure it against danger from a flood similar to that which caused the injury, which required a corresponding increase in the height of the masonry of the piers and abutments, as well as the taking down the same height of old masonry before commencing, in order to put in the new skew-backs at the proper points for the increased elevation of the bridge, being equivalent to *six* feet in height of masonry on all the piers and abutments. The ice breakers were also raised *seven* feet above their former height, to guard against injury from floods in future.

The Board did not hesitate to adopt the alternative of rebuilding *at once,* as the best calculated to promote the interest of the commonwealth, as well as to facilitate and retain the trade and transportation upon the public improvements. The expense attending the towing of canal boats across the river at Clark's ferry, would amount annually to more than three times the interest on the cost of rebuilding the bridge, without taking into view the tolls received for travel upon it, amounting to about an average of two thousand dollars annually. This work will have cost for its reconstruction, when completed, the sum of thirty-six thousand nine hundred and seventy-two dollars and fifty cents, of which sum, twenty-two thousand three hundred and seventy-five dollars and eighty-nine cents was expended and paid before the close of the fiscal year. Ten thousand dollars of the aggregate cost of rebuilding was rendered necessary by injury from the flood, and provided for in the appropriation for that object, made by the acts of the 1st and 20th of April, 1846. The balance of the aggregate cost was occasioned by the fire. This bridge was so far advanced towards completion, as to be opened for travel on one of its road-ways on the second day of the present month, and the commonwealth has since that date been receiving toll for its use, as heretofore. Upon the *Juniata division*, the largest expense incurred in extraordinary repairs, was for the rebuilding of the Shaver's Ford aqueduct, and the out-let lock at Lewistown. The Shaver's Ford aqueduct was destroyed by fire in the month of September, 1845, and no doubt is now entertained of its having been fired by an incendiary. Its place was supplied by the erection of a temporary trunk, supported by trestles, which answered for the purpose of keeping up the navigation during the remainder of that season.

During the fiscal year just closed, it has been replaced by a new and substantial structure, dispensing with the roof, and increasing the width of trunk from sixteen to eighteen feet, and costing the sum of ten thousand five hundred and forty dollars, being five hundred and forty dollars more than was estimated for it by the Board, in their last annual report. This increased cost over the estimate is attributable to the unexpected severity of the weather during the last winter, which prevented the execution of the work as advantageously and economically as was anticipated at the time it was made. The whole of this work had to be done during the winter months, and it was faithfully executed and completed so as to be ready for navigation over it on the 15th of last March. The out-let lock at Lewistown, constructed originally of crib work, and which had become so much decayed as to be entirely unfit for use, was rebuilt during the past summer, at a cost of two thousand one hundred and fifty dollars and seventy-five cents. This improvement will add much to the facility for shipping at this point, which, without the advantage of the outlet, was very much confined and embarrassed.

Upon the *Western division*, between Johnstown and Pittsburg, a considerable amount of extraordinary expenditure has been required in repairing breaches occasioned by floods during the summer, as well as in repairing the injury done to many parts of the work, by the breaking up of the ice last winter. In addition to the current repairs required to keep up the navigation on this division, the superstructures of three aqueducts were renewed last winter, as also extensive repairs to the one over the Allegheny river, near Freeport. A supply of material is now on hand for the thorough and complete repair of this work during the ensuing winter. The crib work protections at dams Nos. 2 and 3, on this division, having become much decayed, and having sustained severe injury from the ice floods last spring, were partially carried away by the heavy freshets during the summer. These have been replaced in a substantial and permanent manner.

Delaware Division.

Arrangements had been made for an early opening of navigation on this division of the public works, but in consequence of the extensive injury to the canal by the spring flood, it had to be delayed until about the middle of April, at which time it was resumed, and has been continued without further interruption throughout the season. The special report of the Board (already noticed,) to the last Legislature, relative to the damage done to the State works, caused by the flood in March last, will show that, in proportion to its length, this division of canal suffered more severely by that flood than any other portion of the State improvements. The prompt action of the Legislature in providing the necessary funds for its repair, together with the energy and perseverance of the supervisor, and those under his direction, in the discharge of their several duties, enabled the Board to have it placed in condition for resuming the navigation upon it at the time above stated. The annual current repairs to the canal banks, protecting them with rip-rap repairs to locks, aqueducts, waste weirs, &c, have all been attended to during the summer, and the canal is now in excellent order for an early resumption of navigation on it next spring. This division of the Pennsylvania improvements, during the fiscal year just closed, has yielded a revenue nearly equal to the interest upon two millions of dollars, after paying all the current repairs and other expenses, as well as the extensive repairs rendered necessary by the freshet of last spring.

In pursuance of the act of 20th April last, authorizing, under certain conditions, the construction of an out-let lock at Well's Falls, the Board advertised for proposals for the loan authorized by said act, to be received at their office until the 10th day of July last; no offer to take the loan, however, was received, and the Canal Commissioners were therefore under the necessity of postponing any further steps towards carrying out the object of the enactment.

Susquehanna and North and West Branch Divisions.

The opening of navigation upon the Susquehanna division was delayed until late in the month of May, in consequence of the great injury it sustained by the spring flood and subsequent freshets in the river. The West Branch division was ready for navigation in April, and the North Branch early in the month of May, but as these two branches were of little use until the communication with the main line, through the Susquehanna division, was complete; it was near the last of May before the navigation throughout could be said to be open. In addition to the repair of the damages to these lines, and the ordinary current repairs, a large expenditure has necessarily been made in the reconstruction of the superstructures of four aqueducts, and thoroughly tightening and securing the Shamokin and Nanticoke dams.

The Shamokin dam had been repaired by contract for a considerable portion of its length, and the work was suspended in 1842. During the past season the remaining portion of it, 1154 feet in length, has been thoroughly re-covered on the upper slope, and, it is believed, made sufficiently tight to supply the canal with water without a resort to coffer dams during the low stages of water, as has been the case for many years past. At the Nanticoke dam a substantial crib work has been placed below the old dam, extending from the canal side of the river some distance beyond the angle, and about one hundred feet more than half its length. The sickness which prevailed among the laborers at this work prevented its completion; but it is believed that the portion of the dam most likely to sustain injury from the spring freshets has been secured, and the remaining portion can be protected during the next summer so as to render it beyond danger for years to come. The accompanying tabular statements, numbered 1, 2, 3, and 4, are referred to as exhibiting in detail the cost of the repairs made on the several lines of improvement, which is deduced from the reports of the several supervisors having them in charge—an estimate of the sum necessary for that object during the fiscal year 1847—a statement of the damages awarded by the Board under general and special laws, and the tonnage shipped upon the several lines of improvement.

In accordance with the provisions of the act of the 31st January, 1846, the Board received proposals for completing the Eastern, and progressing with the work at the Western, reservoir, to the amount appropriated thereto.

The Eastern reservoir being nearest to completion, and of the most pressing necessity, was allotted to H. L. Patterson, he being the lowest bidder, and a contract was entered into with him according to the provisions of the act, for completing the work, which has been prosecuted by him throughout the season with considerable energy, and the sum of fourteen thousand six hundred and eighty-one dollars and eighty-four cents of the amount appropriated thereto, has been drawn and expended in carrying it on. The progress of this work has been delayed by frequent freshets in the South Branch of the Juniata, but no doubt is entertained of its completion in time to be made available before the next season of low water. The amount appropriated for this work will be sufficient for its accomplishment. The large expenditures required for repairing the damage by the last spring's flood to our public works, induced the Board to defer placing the work at the Western reservoir under contract at the time they had intended, and no measures other than receiving proposals for it have been taken for its prosecution. Although some delay and embarrassments have occurred to the business upon the main line during the past season, occasioned by a scarcity of water in the canal, yet it has not been the case to so great an extent as during several preceding years.

In obedience to the requirements of the act of the 10th of April, 1846, relating to the assessment of damages on the Erie extension, the Canal Commissioners visited that work in the month of August last, and made a personal examination of the injured premises, in all cases where applications for damage had been laid before them. These claims have not yet all been acted upon by the Board; some of them having been delayed to afford the claimants opportunity to collect and send on additional testimony, which they were anxious to do. They will all, however, be determined as soon as practicable, and a report of the decision in each case will be certified in accordance with the provisions of the act above recited.

It is a matter of regret that there are some meritorious claims in the vicinity of the Conneaut reservoir, which the Board found had been acted upon before the damage caused by the completion of that work had been fully developed, and awards made, which do not afford adequate remuneration to the claimants; but inasmuch as the act referred to, did not confer any authority on the Board to review such cases, they were obliged to decline entertaining all applications for *review* which were presented to them.

The appropriation for rebuilding and repairing the public and farm bridges, made in 1844, has all been expended for that object; and during the last season several cases occurred which rendered it necessary, under existing laws, for the Board to direct them to be repaired and paid for out of the ordinary repair fund. It is hoped that the Legislature will no longer defer a decision of the vexed question, which has so often been presented to them, whether these bridges over the canal, erected for the accommodation of individuals and communities, shall be kept up by such individuals and communities, or by and at the expense of the commonwealth? If it is determined that they shall be maintained by the latter, the sum of fifteen thousand and eighty-five dollars, in addition to the amount estimated as necessary for ordinary repairs during the fiscal year, 1847, will be required for that purpose. The balance of the appropriation made by the act of 17th February, 1845, for the purchase of new trucks, which remained unexpended at the date of the last annual report of the Board, has during the past year been all expended for that purpose.

Of the amount appropriated for the payment of damage on the canals and railroads of the State, by the 24th division of the 1st section of the act of the 20th April last, there have been warrants drawn for the sum of ten thousand four hundred and ninety-three dollars, up to this date, and it is believed, the balance will be ample to cover all the awards made prior to the passage of that act, which remain unpaid, and may be applied for prior to the 1st day of June next, to which it is alone applicable. Awards have been made by the Board, under general and special laws, during the fiscal year just closed, for damage on the public works, (exclusive of those on the Erie extension) amounting in the aggregate to the sum of twelve thousand six hundred and eighty-eight dollars, for the payment of which no appropriation has yet been provided. The amount awarded to each claimant will be seen in the accompanying statement, numbered 3. This sum will therefore require to be appropriated for that purpose.

The injuries to the public works of the State by malicious persons, are becoming of so frequent occurrence as to induce the Board to believe that some further provision by law, for bringing the perpetrators to justice, is required to prevent their recurrence. The burning of the Shaver's Ford aqueduct was, as has been stated, doubtless the work of an incendiary; and, during the past summer, the Board received such information as induces them to believe, that the perpetrator of this outrage could have been brought to trial and convicted for it, if a suitable reward could have been given for his apprehension. The cutting of the rope on the Schuylkill inclined plane, on the night of the 6th of November last, was another act of malicious mischief, which, but for its timely discovery, might have resulted in the most disastrous consequences to the lives of the passengers on the road at that time.

It is a matter of regret that there was no means at the disposal of the Executive, or the Board, to offer as a suitable reward for the apprehension of these offenders. It is therefore respectfully suggested to the Legislature, as the best mode of preventing a recurrence of these dangerous offences, that a small contingent fund be placed at the disposal of the Executive, to be applied, under the direction of the Canal Commissioners, to defraying the expense of bringing the perpetrators of such offences to trial and punishment.

By reference to statement No. 2, accompanying this report, it will be seen that the estimated cost of repairs, ordinary and extraordinary, including the completion of the Clark's Ferry bridge, and the rebuilding and repairing of the public and farm bridges over the canals, amounts to the sum of $273,609·98, from which, if the sum of $50,000, appropriated by the act of 20th April last, for providing materials and repairs after the 1st December instant, be deducted, it will leave $223,609·98, as the sum required to be appropriated for maintaining the canals and railroads of the State in proper repair during the fiscal year ending on the 30th day of November, 1847. In addition to the last mentioned sum, an appropriation of $50,000 for the preparation of materials and for executing repairs after the 1st day of December next, should be made at the coming session of the Legislature; as also an appropriation of about $25,000 for the repair of breaches in the canals, or other casualties that might occur, and which can be much more economically repaired if the funds are already provided, than by having the work required for that purpose done on the credit of the State, and waiting the future action of the Legislature to provide for its payment.

In a former part of this report it has been shown that the whole amount expended, during the past fiscal year, for maintaining the motive power upon the two railroads of the commonwealth, repairs of the canals and railroads, ordinary and extraordinary, and compensation of all officers and agents, amounted in the aggregate to the sum of $709,930·91; of this sum, $111,515 was required for repairing the damage done by the extraordinary flood in March last, and the further sum of $12,375·89 in repairing the damage by fire at the Clark's Ferry bridge, as also the sum of $8300 in fitting up and maintaining steam power for towing the canal boats across the pool of the dam at that point: making an aggregate of $132,190·89, which could not be foreseen at the date of the last annual report of the Board. This deducted from the aggregate, the sum above stated, would leave the expenditures for ordinary objects but $577,740·02, which, deducted from $1,295,494·76, the gross receipts of the year, will leave as net revenue the sum of $717,754·74, to which sum may be added the amount of tolls which would have been received over and above the actual gross receipts above stated, if the opening of the navigation had not been delayed by the damage from the flood last spring, for some six weeks later than could have been previously anticipated, which is at least $150,000, and it will give the sum of $867,754·74 as the amount which would have been realized as the net revenue of the year, had no greater difficulties and casualties occurred during the last, than were annually encountered for four or five preceding years. This statement is presented for the purpose of shewing, that if no extraordinary casualty should occur during the coming year, to increase the cost of repairs or interrupt the early opening of the navigation next spring, the net revenue which will be derived from the improvements of the State, may be reasonably estimated at the sum of $850,000, for the fiscal year ending on the 30th day of November, 1847.

In the appropriation bill of April 20, 1846, the usual contingent fund for breaches, &c., was omitted; and a large amount of extraordinary repairs of this character have been made during the past season, rendered necessary by frequent floods, land slides, breaches, and other casualties. These causes have operated to exhaust existing appropriations for repairs of the canals and railroads, and unless funds are immediately provided, the current repairs during the winter cannot be as promptly and economically made as they ought to be. It is therefore suggested to the Legislature, that of the amount estimated as necessary for the repairs of the canals and railroads for the year, 1847, the sum of thirty thousand dollars should be immediately appropriated.

Wm. B. Foster, Jr.
J. Hartshorne,
James Burns,
Canal Commissioners.

Canal Commissioners' Office,
Harrisburg, December 31, 1846.

The Gauge Commission.

Analysis of Evidence given before the Royal Commissioners appointed to investigate the subject of the diversity of Railway gauges.

Continued from Page 93.

George Parker Bidder, Esq.*: Is in the immediate management of the lines in Norfolk, and the Peterborough line. From his connexion with Mr. Stephenson, has more or less information of the lines with which he is connected. With respect to the great increase of cost which Mr. Gooch says exists upon the narrow gauge lines for the locomotive power of the goods trains, the cost upon the London and Birmingham and the Grand Junction being double what it is upon the Great Western, is prepared to dispute that fact entirely; but, there are circumstances which might affect that comparison as to the particular character of the goods trade. On one line it may be necessary to have trains which may have to pick up goods at different stations, so as not to carry the same load from the terminus, and at the same time to have the same engine power; and there may be a variety of other circumstances. For instance, on the Norfolk railway, at present, the connexion is not completed of the two railways at Norwich on account of a bridge of an original construction, a swing bridge; so that the fish is brought from Yarmouth to Norwich, then discharged, and carried across the river, then loaded again, and then brought to London, and those trucks go back light. Therefore if you were to take the actual cost of locomotive power for the goods there, you would have to charge two miles of locomotive power for one mile of effective traffic, and consequently, although the locomotive engines might be running at actually a less mileage than another line, yet in that sort of comparison, they might be made to appear to be working at a greater cost. Therefore, unless you have all the circumstances brought before you, any comparison of that nature appears to be not conclusive.

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* The editor (of the Civ. Eng. and Arch. Jour.) has felt it his duty to append to this evidence some comments, which will be found in their proper places, inserted in brackets.

It does not appear that very much higher rates of speed would be required. There would be much more convenience from giving frequent departures, than from running particular trains at a very high velocity. And there is another question; after you have attained a speed of 40 or 45 miles an hour, the saving of time by the increase of speed does not go on *pro rata;* it is very much diminished. You save a great deal of time by an increase from 20 miles an hour to 40 miles an hour; but an increase from 40 to 50 miles an hour is not of that importance. With the present permanent way, where the rails are 70 to 75 lb. weight, you might travel certainly at 70 or 80 miles an hour.

The repairs are very much augmented by bad curves, and a wide carriage, or a wide engine, must be subject to a greater torsion from curves than a narrow one. Cannot believe that it is possible that the repairs of the wide gauge carriage and engines can be so little as of the narrow. Has no experience of the repairs on the wide gauge, but on a bad curve line the repairs are very much augmented. On the Newcastle and Carlisle, the repairs of the engines, as compared with the North Shields, are about £250 per engine per annum.

Has a return of the performance of a goods engine in ordinary working on the Midland line between Derby and Rugby; and whether you take it as the actual weight moved or the evaporating power, it stands a favorable comparison with any engine referred to in the evidence of Mr. Gooch. In one trip the engine took from Rugby a gross load of 348 tons 16 cwt., to which you would have to add her own weight and that of her tender, about 35 or 36 tons. She took that load up 16 feet a-mile from Rugby, and she acquired a velocity for that 16 feet a-mile, of 15 miles per hour. If you compare that with a level line, it is equivalent to a gross load of very nearly 700 tons on a level. The quantity of water evaporated on that length was 35½ gallons per mile; that is equal to about 100 feet per hour. Now, from the experiments it appears, and it is consistent with one's notions, that the power of evaporation is directly, or nearly so, as the power of blast, that is, the number of strokes per minute, and the volume of that blast. From a return of an experiment on the Northern and Eastern, an engine which, at 30 miles an hour, evaporated not more than 70 or 80 feet per hour, evaporated 150 feet at 50 miles per hour.

[Mr. Bidder here assumes that the resistance to a train of 348 tons, on a gradient of 16 feet a-mile, is the same as that to a train of 700 tons on a level. The conclusion is independent of the velocity, and seems derived from taking the resistance of friction at 7 or 8 lb. per ton. This calculation omits the pressure on the blast pipe, which is a function of the velocity, and the resistance of the air, which is nearly as the square of the velocity, and depends, moreover, *not on the weight* of the train, but on the *surface* exposed to the action of the air. But setting all this aside, the amount of 7 or 8 lb. for friction is not even approximately correct, for it is certain that resistance from the unevenness of the rails, &c., is much greater at high than low velocities. The idea that "the power of evaporation is directly or nearly as the power of the blast," is contradicted hereafter by Mr. Bidder's own figures. Besides, if this theory were true, no water at all would be evaporated when the engine was standing still, for then the blast is not in action.]

On the last experiment the train was reduced to 72 tons 12 cwt. gross, a little more than half the first load. The net speed realized was 43 miles per hour, and the quantity of water evaporated was at about the rate of 190 feet per hour. This engine was a long-tube engine; the tubes are 13 feet long, 15 inch cylinders, 22 inch stroke, 5 feet 6 inch wheels; the area of the fire-box is 49·786 feet, and the heating surface of the tubes 738 feet. Then the letter from which I take this goes on,—"To prove the temperature of the heat in the smoke box I suspended four pieces of metal, viz., one piece three parts tin and two parts lead, one piece one part tin and four parts lead, one piece lead, and one piece zinc, their melting points respectively being 334°, 470°, 590°, and 680°. These metals being suspended immediately above the top row of the tubes, about one inch from the tube plate. I found at the end of the journey that the three first-mentioned metals had melted, but the zinc did not melt in any of the three trips, proving the temperature of the heated air to be about 600°." Now that shows that the temperature of the steam in the boiler being about 312°, and the air, when escaping from the tubes, being about 600°, it is quite clear that every part of those tubes must have been available in heating the water, and in the evaporation of steam; and by a comparison, taking the different loads and comparing them with the experiments of the goods engines, which are of a similar construction, with the same area of fire-box, and the same tube surface, you will find, as nearly as can be, that the evaporating power is a function of velocity, and also the function of the area of the cylinder. This clearly shows that the long boiler not only increases the evaporating power, but increases the economy in the conversion of water into steam.

[" This clearly shows" nothing of the kind. To get at anything like a trustworthy conclusion, the same experiment should have been made with a short-boiler engine, and the results compared. We are not told who made the experiments, or how they were made, and consequently do not know how far they deserve to be trusted. Our confidence, by the by, is not increased by reading that the fact the zinc did not melt proves " the temperature of the heated air to be about 600° :" this makes well for Mr. Bidder's side of the question, but all that can be legitimately concluded is, simply, that the temperature was under 680°—it may have been 670°. The fact that the temperature of the air was about double that of the steam, shows that not nearly all the heat of the former was usefully applied. To economise the whole of it, the hot air must continue to act on the steam till it can impart no more heat to it—that is, till the temperature of both is the same. How can we tell, *a priori*, that, if the experiment had been tried on a short engine, this result would not have been more nearly attained than with the long boiler engine, especially if we are to conclude that " the evaporating power is a function of velocity and also the function of the area of the cylinder," and does not depend on the amount of heating surface? It is to be observed the words, " is a function of," are incorrectly used as synonymous with " is *proportional* to."]

" In these experiments are you well assured that there was no priming ?—Yes, especially in the goods engine ; because, if you take that particular experiment to which I have alluded, where she took 385 tons gross up 16 feet a-mile ; if you take the area of the cylinders and see what quantity of steam must have passed through them in passing over that gradient, and see what was the volume of the steam at the requisite pressure to convey that train, you will find that the quantity of water is more than that which appears to have been consumed, which I attribute to the fact that they must have been using steam at rather a higher pressure than ordinary in the boiler.

" How did you ascertain the amount of evaporation ; after the experiment was over, how did you ascertain the quantity of water ?—They take the gauge of the tender, and the gauge in the boiler, and then they have the superficial area of the boiler at the different heights, and the area of the tender. It is ascertained with very great exactness, and great facility."

[Here Mr. Bidder assumes his proposition in order to prove it. He takes it for granted that there would be no priming, in order to show that there was none. First, with respect to the means of ascertaining the amount of evaporation : his method simply shows the quantity of water *got rid of*—not the amount converted into steam and usefully employed. The water *might* have passed away by leakage or priming,* or the steam might have escaped by the safety valve. But he is assured these contingencies could not have occurred, for he calculated the amount of work done, and the quantity of steam required to do it. He is certainly the first person who has been able to ascertain the resistance to a train with anything like the accuracy necessary for a calculation of this sort, and has increased the simplicity, if not the accuracy, of his operations by taking it for granted that 348 tons on a certain gradient are equivalent to 700 on a level. To find the quantity of water required to do the work, the recipe is to "take the area of the cylinders and see what quantity of steam passed through them," but who but Mr. Bidder could tell *a priori* how much that steam was dilated in coming from the boiler, and what was its precise effect while acting expansively—in other words, the exact nature of its mechanical action? Both problems are, considered separately, so intricate as to baffle all human ingenuity. The first, the resistance offered to the train depends on the wind, concussion at the joints of the rails, friction of the axles of the carriages, and other complicate mechanical actions, varying with every variation of velocity. The second, the mechanical effect of the steam, it is equally impossible to predict. The relation of the power of the steam to the quantity of water used, depends on the temperature and tension in the boiler, and the temperature and tension in the cylinder; the latter varying not only at every stroke, but (when the steam is used expansively) at almost every part of the stroke. It is therefore quite impossible to take the two problems separately; they must be considered together, as De Pambour has considered them. We have quite sufficient proof, however, that Mr. Bidder's calculations were all wrong, from his anomalous conclusion that *more* water was required than was actually expended! In accounting for this anomaly, he lets us into a secret;—he confesses that he did not know the pressure in the boiler, which of course should have been an essential ingredient in his calculation.]

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* De Pambour shows that of the whole quantity of water consumed, one-fourth is, on the average, wasted by being drawn into the cylinders in a liquid state. So much for there being no priming!

A law seems to exist that the power of producing steam is as the velocity, that is, the number of blasts and the volumes in the cylinder; that is, as long as the fire-place will supply you with combustion to that amount; but as you increase the blast the combustion goes on in that ratio; and even with the Great Western experiments, and those taken with a short boiler, it is found almost invariably as the result, that 1 lb. of coke evaporates 7 lb. of water. With the long boiler we hardly ever get an effect of less than 8 lb. of water to 1 lb. of coke, and in some of these experiments it is as much as 10 lb. And we get economy in another way. In a comparison between engine power and the consumption of coke, you may get a fallacy from not knowing to what extent there may be pilotage in one line or another. If an engine on one line has double the amount of engine piloting which there is on another, her consumption goes into the general mileage; whereas the consumption of coke while running may be very much less. On the Northern and Eastern, when that line was first opened to Broxbourne, their engines only consumed 20 lb. of coke while running, and yet the daily returns showed 36 lb.; that was from the quantity burnt at the stations. Now a long-boiler engine is economical in that respect, because, no doubt, from the length of tubes, the quantity evaporated while standing and the coke consumed is very much less; in fact, an engine with 13 feet tubes burns only half the coke standing that is consumed by an engine with 8 feet 6 tubes.

[In the first part of this paragraph the blast is supposed to increase the evaporation, but to also increase the consumption of coke *in the same ratio ;* so that, though more coke is burned in an hour, the effect of each pound of coke is not increased. In other words, the blast is supposed not to increase the *economy* in the use of the coke. Now, it has always hitherto been supposed that a strong current of air (and, therefore, of oxygen) rendered the combustion not only more rapid but more *perfect* also, and that, where the supply of oxygen was insufficient, a great part of the fuel was wasted and passed away unconsumed, or without developing its evaporative power. It is, therefore, concluded that the rapidity of the current of air (within certain limits, of course,) increases the actual economy in the consumption of fuel. In the last sentence in the paragraph, " the quantity evaporated while standing" by a long boiler engine is supposed to be less than by a short boiler engine ; and yet the principal argument in favor of the long boilers has always been understood to be their increased amount of heating surface, which might be supposed to increase the quantity of water evaporated, whether the engine were standing or in motion.]

" Do you think any good would result from the use of corrugated metal for fire-boxes ?—I do not think there would be any. They get apparently a larger surface ; but I think the effect upon that surface must be weakened to the same extent as you happen to extend the gauge. With a certain amount of combustible matter in a pound of coke, if you get the whole of that out, which we do with a long-tube engine more effectually than they do with a shorter one, from the fact that we get 8 lb. of water evaporated instead of 7 lb., I do not see myself how you can do more than extract that matter and apply it usefully ; it does not matter whether it is in the fire-box or in the tube."

[Mr. Bidder does not see any use in increasing the surface of the fire-box, because " you can do no more than extract the matter and apply it usefully." But, then, that is assuming that *all* the matter is applied usefully in the long-boiler engines ; whereas, he himself has proved that this is not the case, from the fact that the temperature in the tubes is twice that of the steam.]

There is a great difference of opinion respecting the atmospheric resistance ; the fact has come before me from the experiments not only with the locomotive engines but on the atmospheric railway, where I see the power that has been expended and the result, and I cannot account for the expenditure but by atmospheric resistance, or some resistance which is a function of the velocity. For instance, I take a locomotive engine, No. 6, on the Northern and Eastern. I put behind that engine a train of 100 tons, she will travel with that train at the pace of 30 miles an hour and she will evaporate at the rate of 80 feet per hour. I reduce those 100 tons to 20, that engine goes at 50 miles an hour and evaporates at the rate of 150 feet per hour;

and I find, as nearly as can be, that the same quantity of water is converted into steam per mile with the light train as with the heavy train, showing that the *pressure upon the piston is nearly the same,* and that the power has been absorbed by this great augmentation of resistance.

[The blunder marked by italics rivals the celebrated notion started in the investigation of the Norfolk railway accident that an engine can be forced off the rails by the suddenly shutting off the steam. In the present case, Mr. Bidder evidently disregards the fact that the quantity of water drawn into the cylinder in a liquid state is much greater at high than at low velocities. Otherwise, how could he conclude that, because the same quantity of water was consumed during a slow as during a fast journey, the cylinder-pressure was the same in both cases? It is impossible to estimate the effective vaporisation by the water consumed; for even the mere circumstance of the boiler being fuller at one time than another will account for an enormous increase of priming. The inconsistency of this paragraph, with that in which Mr. Bidder states that he is "well assured there was no priming" is also to be noted. *There* he was able to calculate the resistance to the train with the utmost exactness; all language of uncertainty was avoided,—we were told to "*see*" the resistance of a train passing over a certain gradient, as if this *seeing* were the easiest process in the world. *Here,* however, the resistance is treated in quite a different mannner—it is some very vague uncertain thing, which Mr. Bidder "cannot account for" but by supposing there is "some" force or another (he knows not what) functional of the velocity. *Here,* too, the resistance can only be ascertained from the vaporisation. *There,* it could be calculated independently of the vaporisation—aye, and with that precision that the amount of priming could be deduced from the calculation. It is important to observe that, at ordinary boiler pressures, steam occupies *from four to five hundred times* the space of the water from which it is produced. This shows how enormously the evaporation is exaggerated by neglecting the effect of priming.]

The following are extracts from Mr. Bidder's report on the results of the experiments tried with the broad and narrow gauge engines:—

"Before calling your attention to the facts shown in these experiments, which cannot be influenced by any circumstances, and which, in my opinion, are alone worthy of your notice, I repeat that the object proposed was to ascertain the truth (and that alone) of statements which had respectively been made by Mr. Gooch and myself, as to the comparative power and economy of engines now in operation on the broad and narrow gauge lines, and more especially with respect to the importance of surface obtained by increasing the fire-box, or lengthening the tubes, and that any inference drawn from the results which shall bear on the merits of the two gauges will be foreign to the objects proposed, and false, as the circumstances of the experiments are not found to obtain in practice. Supposing, however, that they were, and that an increase of power were deemed desirable, I do not hesitate to say that that which is at present found ample for all purposes might be doubled, or more than doubled, on either gauge.* I shall now proceed to examine the evaporating power of the engines, as well as the relative economy of evaporation and efficient application of the steam evaporated. It will be recollected that on the part of the broad gauge, it was alleged (in reference to the statement that on the narrow gauge, not only economy but power was obtained by lengthening the boiler) that the area of the fire-box alone was the test of the power of the locomotive engine, and that two cubic feet of water per hour per superficial foot of fire-box gave the capacity of evaporation of locomotive engines; and thus it was alleged, that the Great Western engines could evaporate nearly 200 cubic feet per hour, while the narrow gauge engines could only convert into steam 100 cubic feet, the comparative fire-box surfaces being as 97 feet to 50 feet. In order at once to test this principle, let us examine the facts shown in the experiments. By reference to the particulars of the experiment with 50 tons with engine A, on December 31st, 1845, between Darlington and York, a distance of 88½ miles, it will be found that the water evaporated is 20,520 lb., being at the rate of 232 lb. per mile. In the (up) journey the first mile, as well as the last 1¼, were passed over slowly; as also were the first quarter and last mile on the return trip, in all 3½ miles. In order, therefore, to get at the maximum average rate of evaporation on the trial, I take 20,250 lb., less 812 lb. (the water consumed in passing over the above 3½ miles, at the rate of 232 lb. per mile), 19,700 lb., the weight of water evaporated by the engine in passing over the remaining 85 miles, which was effected in 106 minutes 12 seconds, being at the rate of 11,150 lb., 178 cubic feet per hour. I will now compare this with the experiment most resembling it in regard to the evaporation tried on the broad gauge. I take the experiment with 60 tons on December 17th. The total water evaporated was 24,640 lb., on 106 miles, or 232 lb. per mile: deducting from this 1,044 lb. for water due to 4½ miles passed over slowly, leaves 22,596 lb. of water evaporated in 112 minutes and 42 seconds, being at the rate of 11,820 lb., 189 cubic feet per hour, that is little more than the evaporation of the narrow gauge engine. When, however, we compare the coke, we find, in the case of the broad gauge engine, that 7·8 lb. of water only were converted into steam by 1 lb. of coke, whilst the narrow gauge engine evaporated 9·6 lb., being a difference in regard to economy of fuel of 23 per cent. in favor of the narrow gauge engine."

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* "In evidence given by Mr. Gooch, the average gross weight of passenger trains on some of the principal railways is given as follows:

——	Great Western Railway.	Grand Junction Railway.	London and Birmingham Railway.	Birmingham and Gloster Railway.	South Western Railway.
Average gross weight in tons.	67	43	42	38	36

The lightest of the trains included in the above average are express trains; there are now, therefore, engines in use on both gauges capable of taking trains of double the weight of those required in practice of the express speeds."

From the concluding sentence of this quotation, it is clear that Mr. Bidder's only test of the relative economy of the two engines is—not which does the greatest quantity of work for a given quantity of coke—but, which gets rid of the greatest quantity of water for a given quantity of coke: and, accordingly, he has drawn up a tabular account of the experiments, wherein, in the very cases in which the broad gauge engine evidently did the most work with a pound of coke, he concludes that because it did its work with a small quantity of water, *therefore* the engine was comparatively ineconomic! If the table were not actually printed and published, our readers might perhaps doubt whether we had fairly represented its contents. The following, however, is an exact copy:—

Experiments.		Engine.	Water evaporated per mile.	Coke consumed per mile.	Water Evaporated per lb. of coke.	—
No.	Tons.		lbs.	lbs.	lbs.	
1	80	Ixion,	245	33·6	7·12	Broad gauge.
2	70	Ixion,	233¾	33·6	7·12	
3	60	Ixion,	232	29·6	7· 8	
1	50	30th Dec., A.	291	31·2	9·3	Narrow gauge
2	50	31st Dec., A.	232	24·	9·6	
3	80	31st Dec., A.	235·7	26·6	8·8	

The fifth column gives, according to Mr. Bidder's views, the figures by which the economy of the engines is to be tested. Let us take the first experiment in each case. In the narrow gauge experiment, No. 1, the train was 50 tons, and the consumption of coke 31·2 lb. per mile: in the broad gauge experiment the train was 80 tons, and the consumption of coke *not* 2½ lb. *more per mile.* It is obvious that the 2½ lb. will not alone account for the enormous difference between the two loads—namely 30 tons. The only conclusion which any rational unprejudiced man could draw would be that more work was got out of the coke in the one case than in the other. And this conclusion would be greatly confirmed by observing what Mr. Bidder omits mentioning, that the broad gauge train moved *fourteen miles an hour faster* than the narrow gauge train. And yet, because the water evaporated was less in one case than the other, we are provided with a fifth column of "water evaporated per lb. of coke," from which it is gravely inferred that the narrow gauge trip was performed the most economically! We must protest against this wholesale method of jumping at conclusions which shows a lamentable confusion of ideas respecting the mechanical action of steam.

We said that Mr. Bidder's own figures contradicted his hypothesis that "the quantum of evaporation is a function of [*i. e.* is proportional to] the number of blasts per minute." Taking Nos. 1 and 3 of the broad gauge trips, which were respectively the slowest and fastest trips, the quantity of water in the first case was the *greatest* (viz., 245 lb.) and in the second the *least* (viz., 232 lb.). We get precisely the same result with the fastest and slowest of the narrow gauge journeys: so that if Mr. Bidder's table prove any relation of the evaporation to the blast at all, the conclusion must be the very reverse of his theory. It has been ascertained that, if an engine be deprived of its blast pipe, the rate of evaporation will be reduced to about one-fifth; but from the few experiments instituted under this head, it would appear that under ordinary circumstances, when the blast is in action, its effect on the rate of evaporation varies as the fourth root of the velocity.

Before concluding these observations, we ought to offer some remarks on the particular circumstances under which the narrow gauge experiments were made. The following extracts from Mr. Gooch's report are not a little surprising "*The engine was on each occasion placed at Darlington over a powerful stationary blast for the purpose of getting very hot water in the tender and a bright fire to start with.*" By these means, the water in the tender was raised to 180°. In the experiments with goods trains, "*the engine was placed over the blast, and remained there an hour and a half. The tender containing warm water was taken from another engine and attached to the regular tender, and men were provided to bucket the water from one tender to another as the train was moving.*" Mr. Gooch plaintively observes that this contrivance would have been of great use in the broad gauge experiments.

The love of philosophical accuracy displayed by the conductors of the narrow gauge experiments precludes the supposition that *they* sanctioned these devices, which must therefore be attributed to the subordinate officers of the railway. But, at all events, they sufficiently account for the circumstance that the narrow gauge engines got rid of more water for each pound of coke (although they generally did less work for each pound of coke) than the broad gauge engines. It is, of course, more easy in the dead of winter to boil water previously raised to a temperature of 180° than water originally at the temperature of the atmosphere.

We must guard ourselves against the supposition that the experiments prove decisively the superiority of the broad gauge engines. In fact, they prove *nothing*. They were so few and so improperly conducted that no trustworthy conclusion can be derived from them. They ought to have been repeated several times over, under the superintendence of disinterested persons, whose object was—not to get up a series of showy results—but to exhibit as nearly as possible, the *ordinary* working of either kind of engines. However, the observations here made will have, at least, one good effect: they will enable the reader to appreciate the philosophy given in evidence before public commissions on engineering questions, and to estimate the value of the experiments authoritatively sanctioned.

Civ. Eng. & Arch. Journal.

Extracts from "Observations on the Western Trade," in reference to the proposed Hudson River Railroad. By Wm. H. Grant, Civil Engineer.

I have obtained from Legislative documents, the yearly statements of the "*Assessed value of Real and Personal Estate in the city of*

New York," from 1815 to 1845, inclusive, and arranged them in the following table.

Chronological Table of the Assessed value of Real and Personal Estate in the City of New York, from 1815 *to* 1845, *inclusive.*

1815	$81,636,042	Close of the last war with Great Britain.
1816	82,074,200	
1817	78,895,735	
1818	80,245,091	
1819	79,113,061	
1820	69,539,753	
1821	68,285,070	
1822	71,289,144	
1823	70,940,820	
1824	83,075,676	
1825	101,160,046	Completion of the Erie Canal.
1826	107,477,781	
1827	112,211,926	
1828	114,019,533	
1829	112,526,016	
1830	125,288,518	
1831	139,280,214	Completion of the Ohio Canal, from Cleveland on Lake Erie to Portsmouth on the Ohio river; distance 307 miles.
1832	146,302,618	
1833	166,495,187	
1834	186,548,511	
1835	218,723,703	
1836	309,500,920	
1837	263,747,350	
1838	264,152,941	
1839	266,882,430	
1840	252,135,515	Completion of the Western Railroad, in connexion with the Boston and Worcester, and the Albany and West Stockbridge Railroads, extending from Boston to Albany; 200 miles.
1841	252,194,920	
1842	237,806,901	
1843	229,229,077	
1844	236,727,143	
1845	239,995,517	

Running the eye over this table, it will show, at the first glance, its striking aptitude as an index to the growth and prosperity of the city of New York.

The three principal eras are strongly marked.

I have already alluded to the stationary position she held from the close of the war to the completion of the Erie canal, in 1825, while Pennsylvania was monopolizing the western trade, which is so strongly exemplified by this table; and also, to her sudden start in wealth and rapid increase from that time onward to 1840, about the period of opening the Western railroad.

In 1832, it will be seen, an additional impulse was given to the trade by the Ohio canal, opening an important avenue to Lake Erie. From 1825 to 1840 and '41, it shows, in an unerring and demonstrative manner, the constant and unchecked increase of the wealth of New York.

In 1841, the assessed value of real and personal estate in the city was $252,194,920,—it had ranged higher in 1836 and the three years following, during the inflated period, when every species of property obtained a fictitious value,—but it is $33,000,000 higher than in 1835, and shows an annual increase of 8 per cent. for the last preceding ten years, and of 9⅓ per cent. for each year from 1825. It may be regarded as a fair and substantial valuation for that time. And what follows from this period? It stops here as firmly as if the city had been visited by some fearful calamity.

This may appear somewhat incredible; but cast the eye back again upon the column of figures, and trace it down; there is no longer the steady increase; there is an actual diminution; follow it down to 1845, and there is a falling off since 1841 of $12,000,000! There is nothing fallacious about it. There are the figures.

The ascending ratio no longer holds good, but it is actually inverted; instead of increasing at the rate of 9⅓ per cent., or 8 per cent. per annum, *the value of real estate has declined at the rate of nearly* 1¼ *per cent. per annum from* 1841 *to the present time!*

New York, for the first time in sixteen years, has received a check in her career. Worse: for the first time in her whole history she has retrograded.

Her positive loss has been $12,000,000, which has been absolutely abstracted from her wealth. Let us continue the ratio of increase for the ten years preceding 1841, of 8 per cent. per annum, the lowest possible ratio that could be applied, and see what her valuation *should* have been in 1845. An annual increase of 8 per cent. on the sum of $252,194,920, the valuation in 1841, makes $332,818,880. The difference between these two sums is, in round numbers, *eighty-one millions of dollars, which is the loss she has practically sustained in the last four years; an amount greater than her whole wealth two years previous to the completion of the Erie canal, and equal to one-half of the entire wealth she has accumulated since it has been in operation.*

These are facts that every man can investigate for himself. They may appear incredible, and doubtless would be held so, were not the evidence, "clear as proof of holy writ," at hand. They are stubborn and startling *facts*, that must be looked full in the face; they cannot be evaded.

I could mention a number of instances in which they have been stated to men of intelligence and high business qualifications, who have received them with the most positive unbelief and incredulity; and I believe it is not presumptuous to say that half of the active capital held in the city of New York, is held by persons unconscious,—if not of their real existence, of their extent and consequences.

What! is it to be believed that New York, with her great resources, her enterprising population and fertile soil, her unrivalled natural advantages, is for a moment to pause in her proud career? New York, with her magnificent bay and harbor, her boasted Hudson, and her "grand Canal," with the connected system of internal improvements embracing 700 miles of artificial navigation,—to retrograde in her giant progress, and to sink annually for four years $3,000,000, instead of accumulating 10½ millions, which is but the average rate of increase for 16 years previous to 1841? No; it is idle to talk of it; it is absurd, and contrary to all experience and all habits of thinking and observation. Mathematical demonstration will scarcely prove rigorous enough to establish it on the minds of half a million of people, whose every interest, great or small, is opposed to it.

Our "Grand Canal," truly! why it has been made subservient, with our whole canal system, and our line of railroads from Albany to Buffalo, to the city of Boston; our internal resources, industry, and capital, and even our merchants, mechanics, and farmers, have become tributary to her.

Look about the land,—in our populous towns, villages, and hamlets along the thoroughfares to the west, to the north, and into the interior,—and see if you do not find the enterprizing New Englander established there, fresh from Boston, with his wares and manufactures, and merchandize, and "notions" of all descriptions, and competing successfully with our citizens. Look at the manufacturing establishments springing up from Massachusetts capital, and even railroads projected and carried into operation by it on our own soil, all tending to the same end—to build up Boston at the expense of New York. Look at the trains of the Western railroad as they depart from the depot at East Albany, and see if they are not loaded down and groaning under the burden of our own products and the products of the west, carrying our merchants and the merchants from distant States, that formerly thronged to New York, rapidly and en masse to the city of Boston. See them return with similar burdens, and sending them far and near, scattering them broadcast throughout the country, to the exclusion of the legitimate trade of New York. And this too, while the channels of competition are all open, and the Hudson river is offering its superior navigation of 150 miles against 200 miles of railroad, over mountains and on unparalleled grades.

But more than all; see this *only* avenue to New York closed and hermetically sealed nearly one-third of the year, and the whole trade of the interior and the west, without stint or diminution, concentrating upon the city of Boston.

After this, say if the evidence these things furnish does not confirm and strengthen the humiliating fact, that New York has been shorn of her strength, has fallen from her high position, and in proportion as she has declined Boston has triumphantly risen.

But let us turn our attention to Boston and ascertain how the case actually stands with her. In 1841 the value of her real and personal estate was but $98,000,000; it increased by regular gradation from that year to 1845 to $135,000,000, making an advance, in the four years, of $37,000,000. This is equal to 9⅓ per cent. annual increase, and equal to the highest rate New York has ever attained. If we take the rate of 8 per cent. at which New York advanced previous to 1841, and the rate at which she should have continued to advance, and add to it the rate of 1¼ per cent. which shows her decline since, *it corresponds, within a fraction, with the actual per centage gain of Boston.* Her progress has been truly astonishing, considering her past history and comparatively slow and toilsome advance through a long series of years. It surpasses that of Philadelphia in her palmiest days, when the entire western trade was poured into her lap.

To show the influence the Western railroad has had in producing these results, let us look at the business it is doing. The bare receipts of the road for transportation were, in

1842,	$ 512,688	1843,	$ 573,882
1844,	753,752	1845,	813,480

For the last year they were $813,480, a sum that would in itself enable a sagacious person to form a tolerably correct estimate of the value of the immense business to Boston, from which it is derived from transportation alone.

The number of tons of merchandize carried over the road from 1842 to 1845, averaged yearly 66,000, and was, in 1845, 93,392 tons. To assign a value to this amount of merchandize, approaching accuracy, is perhaps no easy matter, but still it may be approximated very closely.

The "total movement" on all the State canals during the last season, of articles similar to those transported over this road, included under the several heads of "Agriculture," "Manufactures," and "Merchandize," (excluding "products of the forest,") was 867,000 tons, the value of which, as officially ascertained and reported to the Legislature, was $89,000,000. From this proportion the value of the 93,392 tons carried over this road is found to be *nine and a half millions*, which is, with great probability, very near the mark.

The "total movement" on the canals is made up of the amounts ascertained to have moved between the several collectors' offices, and for a greater distance; a large portion moving but a few miles, 5, 10, 20, 100, or 200 miles, as the case may be, and the remainder over the whole line; that is, over the Erie canal, or over one of the lateral canals and a part of the Erie canal. The amount that corresponds the most nearly with this total movement, in the statistics of the Western road, is the "number of tons carried one mile." This, for the year 1845, was 14,569,223 tons. The number of passengers carried over the road was 223,600.

The value of the trade, as before stated, of $9,500,000, is exclusive of the benefits derived from this number of passengers carried annually to and from the city of Boston, forming business connexions, and extending and strengthening her commercial intercourse with the merchants, and producing, and consuming classes of the west.

That Boston duly appreciates these results, and attributes them to the true source,—whatever may be the opinion of New York, or her indifference to the fact—no one can doubt, who gives her credit for ordinary intelligence. She has already contemplated and taken measures to construct a double track to the Western railroad, an improvement demanded by the rapidly increasing business upon it.

All her energies are directed and centered upon the vantage ground she has gained, with a fixed resolution to make the most of the position her superior enterprize alone has given her. She has wisely estimated the value of an uninterrupted access at all seasons of the year with the west, which the progress of trade and the spirit of the age have alike rendered indispensable, and her citizens are fully sensible of the triumph they have gained over the ice-bound Hudson. Daily experience and the most familiar and ordinary business transactions afford them practical illustrations of its importance.

What would they say of the merchant, who, with an active competition around him, keeps his store open but six hours in the day, while others keep their's open nine? What would they say of the mechanic who labors in his shop but two hours to his fellow's three, and lounges away in idleness one-third of his valuable time? Or, what would they say of the capitalist who invests his funds but two-thirds of the year, and hoards them up during the remainder, without receiving a dividend or a return in any manner? They would say, that in one case, the man was wilfully blind and negligent of his best interests, and in the end would be reduced to poverty; and in the other, that industry and prompt attention to advantages open to all, would be sure to secure its deserved reward. Whether New York is passive and indifferent to these facts, or tardily realizes them and endeavors to practise the lessons they teach, Boston will keep on, profiting by her experience, and will retain in her grasp the advantages she has gained with a tenacity that will only yield in the greatest emergency.

Now it may be said, in answer to all this argument about the advance of Boston and the decline of New York,—"True, New York has lost in four years $12,000,000, or you may call it $81,000,000, if you choose, and Boston has gained $37,000,000, but it is merely a temporary fluctuation that the times are subject to; New York will soon regain her position, and outstrip Boston with ease; and, besides, small losses do not affect her, her energies are recuperative, and she emerges from every disaster only to take a higher and prouder flight than her previous one." But is not this a palpable fallacy in view of the actual facts?

New York *has* overcome and outlived great misfortunes; she has nobly risen from her ashes on one occasion and exhibited a renewed vigor and a brighter aspect after it, and she is now emerging (less rapidly) from a similar but less serious calamity. The conflagration of 1835 was a visitation such as few cities could survive, much less efface and repair in ten years; but how was New York situated to meet the blow? She was in the midst of unrivalled prosperity, and all the elements of her undiminished greatness conspiring to alleviate its consequences and raise her from the momentary depression it caused. Her resources were not then distracted or diverted from her, and the chasm made in her wealth was soon filled, and all went on as before. But should such a disaster occur now, how would she be prepared to meet it? Has she ever been placed in a condition similar to the present one? Her trade is departing from her at the rate of $3,000,000 a year, and she has fallen back in 4 years $81,000,000, instead of her wealth being at this time enhanced, as it should be, by that amount. She has experienced no reverses like this, or ever found herself in a dilemma such as it involves, yet she is to extricate herself from it with ease and unconcern!

How is it to be done? Is there some latent spring of revivifying and recreative power within her corporate limits that is to sustain and prop her up in defiance of all extraneous influences? Is Boston to relax her efforts; or upon what tangible evidence does she rest for the great good fortune she anticipates? There may be some resources upon which she relies, not palpable to an unimaginative eye, but to plain practical common sense there is no other than the construction of the Hudson River railroad. If she will look to this, she will see the *means,* and if she will look to the west she will see the *substance* of her relief. The western trade, which has trebled her wealth and has been the real source of her vitality so long as the Erie canal was tributary to her, has been "tapped" by Boston, and the only way it can be recovered is to complete this railroad without delay, and open anew to her the great and commanding advantages she has temporarily resigned.

AMERICAN PATENTS.

List of American Patents which issued in the month of February, 1846,—with Exemplifications, by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in the Straw Cutter;* Samuel G. Blackman, Norwalk, Connecticut, February 10.

The patentee says:—"My improvement is applicable only to that class of straw cutters which cut by means of knives attached to and radiating from the centre of a shaft or roller, and acting against the surface of a cylinder of wood, lead, or other substance. The object of my invention is to prevent cutting into this cylinder, and I effect it by suspending the boxes in which the journals of the cylinder work between helical springs, placed above and below, with temper screws that bear on the top of the upper springs, so that the surface of the cylinder can be regulated at pleasure to make the requisite pressure on the edges of the knives as they pass, and yet not sink so much between them as to injure the surface of the cylinder, and waste the power."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is suspending the boxes on which the journals of the cylinder run between two sets of springs placed above and below, the upper set being regulated by temper screws or other analogous device, in combination with the roller of radial knives that cut against the surface of the cylinder as herein described."

2. For *Improvements in Machinery for making Glazed Cotton Wadding;* Jeremiah Essex, Bennington, Vermont, February 10.

The first part of this invention consists "in ranging a series of carding engines, one behind another over an apron which has a continuous movement, so that the sliver or sheet of cotton from the second card is delivered on top of that from the first, the one from the third on to that of the second, and so on to the end of the series, the number of carding engines being in proportion to the quality and thickness of the bat or wadding desired: it being a fact well known to those versed in the art of working fibrous materials, that the thinner each sliver the more perfect will be the bat, and it will be evident that with my method this can be refined to any desired extent.

"The second part of this invention consists in passing the glazed bat or wadding from the glazing apparatus through the kiln or hot air chamber over a series of open reels arranged side by side on one plane, and extending from end to end of the kiln, one reel delivering the bat on to another, and so on to the last of the series where it is delivered out. If the bat is glazed on both sides before it is introduced into the kiln, but one set of reels is used; but I prefer to glaze it first on one side, dry this by passing it through the kiln on one set of reels, and deliver it at the other end to the second glazing apparatus to be glazed on the other side and then passed through the kiln on another set of reels above the first. In this way I avoid the inconvenience of accumulating the glazing or sizing on the rods of the reels, for in passing through the first time the unglazed surface rests on the bars of the reel, and the second time, the side first glazed. In this way I avoid what would otherwise be a serious inconvenience."

Claim.—"What I claim as my invention, and desire to secure by letters patent. is arranging a series of carding engines one behind another and over a single apron to form a bat of several thicknesses of slivers, as herein described. And I also claim the arrangement of one or more series of reels that rotate by means of cog-wheels or other equivalent, to convey the bat in combination with the glazing or sizing apparatus for glazing or sizing and drying cotton or other bat or wadding, substantially as herein described."

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3. For an *Improvement in the Cooking Stove:* Joseph Lauback, Harrisburg, Pennsylvania, February 10.

This is for an improvement in a cooking stove having one small oven back of the fire place and a large one below, and the improvement patented consists in having a large circular hole (called a diving flue in the specification) in the middle of the flue that passes under the large bottom oven, for the purpose of carrying the draught down into a flue below that leads to the exit flue at the back, the said hole being surrounded by movable segment plates to open or close this hole. When closed the draught passes over the top of the large oven, down in front, under the bottom, and up the back; but when open, and the other dampers are properly regulated, the draught divides into two currents at the top of the oven, one portion passes down the front and the other down the back, both pass under the oven, dive down through this hole into another flue below—and thence up the back flue to the exit pipe.

We are under the necessity of omitting the claim as it depends on the drawings, but it is limited to the arrangement and combination above pointed out.

4. For an *Improvement in the Portable Horse Power for Driving Machinery, called the Locomotive Horse Power;* I. J. Richardson, New York City, February 10.

Claim.—"Having thus fully described the manner in which I construct, combine, and arrange the respective parts of my locomotive horse power for driving machinery, I do hereby declare that I do not make any claim to the manner of arranging the wheels and pinions which constitute the gearing, such gearing being of a kind well known to machinists: but what I do claim as new, and desire to secure by letters patent, is the placing of the master wheel beneath the main beams or body of the carriage in such manner as that it can remain permanently attached in its place as described, in combination with the placing of the residue of the machinery in a separate frame to turn over upon hinges, or a hinge or pivot as above set forth, thereby removing all impediment to the transportation, and admitting of the whole being readily replaced in gear by turning the independent frame back into its working position."

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5. For an *Improvement in Stoves for Heating Apartments;* Charles W. Leet, Vernon, New York, February 10.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of conveying the draught, as before described, that is to say, causing the draught to pass over the upper edge of the front half of the inner cylinder, thence down between the inner and outer cylinders, into the oval base, and thence up the columns into the oval cap, and thence down into the semi-circular space between the inner and outer cylinders, and thence to the smoke pipe as above set forth."

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6. For an *Improvement in the Washing Machine;* John H. Aldrich and Otis C. Foote, Rushville, New York, February 10.

This invention consists in subjecting the clothes, in a tub or box, to the combined action of rubbing, squeezing, and pounding, by means of a rubber, or pounder, connected with a hand lever by means of two jointed links, so that as the lever is depressed, the pounder or rubber shall gradually approach a fluted wash-board at the bottom, rubbing and squeezing the clothes, and then strike against the back of the tub or box, to pound the clothes which have been pushed towards the back, either by the action of the rubber or by the hand of the attendant. One of the links being jointed to the back of the rubber or pounder, and the other to the top thereof, the latter being jointed to the handle about midway between the fulcrum of the hand lever and the joint of the other link, to insure the compound movement of the rubber or pounder.

Claim.—"What we claim as our invention and desire to secure by letters patent, is connecting the pounder or rubber of a washing machine with the hand lever, by means of the two jointed links, to give it the required downward and forward motions, whereby the clothes in the box or tub are rubbed and squeezed, or compressed on the wash-board at the bottom, and pounded against the back, as herein described."

7. For an *Improvement in the Ovens of Cooking Stoves;* Geo. W. Eddy, Waterford, New York, February 10.

Claim.—"My improvement, and that which I claim, and for which I ask for letters patent, consists in combining a hollow oven door, or one with flues within it, with induction and eduction openings or passages in its turning bearings; the said openings being for the reception and discharge of smoke into and from the said doors, substantially in the manner and for the purpose as set forth."

8. For an *Improvement in the Straw Cutter;* Joseph W. Webb, Lockport, New York, February 10.

In a straw cutter secured to the patentee by letters patent bearing date the 2nd day of July, in the year 1842, in which the knives, straight on the cutting edge and face, are connected with the shaft or stock, with the cutting edges on a line diagonal therewith, and the outer face on tangents, so that that end which first commences the cut is tangential to a smaller diameter than the other, or in other words, in which the faces of the knives are tangential to a cone, for purposes fully expressed in the letters patent before recited, experience has shown the importance of having them so connected with the stock or shaft as to admit of adjustment as their cutting edges wear, for it is evident that as the cutting edge wears away, its diameter decreases, and will not act against the bed cutter at the end of the box, and therefore it becomes necessary to attach them to adjustable arms, which, by means of screw-bolts and elongated holes or slots, will admit of the adjustment of the edge of the knives to the edge of the bed cutter or shear; but as the wear from inequality in the texture of the metal, or unequal grinding, is irregular, it frequently occurs that one end must be moved out more than the other, which bends the knives, if secured to flat faces or seats on the ends of the arms to which they are attached, and varies their cutting line; and therefore, to avoid this defect, the ends of the arms, or the faces to which the knives are attached, are beveled on each side, so that they (the knives) rest on the ridges thus formed, and admit of easy adjustment, without the liability of bending.

Claim.—"What I claim as my invention and desire to secure by letters patent, is attaching the knives to the beveled faces of the flanch pieces, to admit of their readily taking any inclination without bending, in combination with the means of adjusting their cutting edge to the bed cutter or shear, by connecting the flanch pieces to which they are attached by screw-bolts passing through elongated holes or slots, substantially as herein described."

9. For an *Improvement in Weavers' Temples;* Arnold Palmer, New Lebanon, New York, February 10.

The object of this improvement and its general character are clearly indicated in the following claim:

Claim.—"What I claim as my invention and desire to secure by letters patent, is the mode of combining and arranging the parts composing my self-acting temple, so that the jaws commence closing upon the selvage while the latter is *advancing towards the filling,* and after firmly holding the cloth, at the moment of 'beating up,' open, and leave it at liberty to vibrate while the sheds are changing. The whole being constructed and operating as described and shown."

10. For *Improvements in the Cooking Stove;* Samuel Graves, Auburn, New York, February 10.

We are under the necessity of omitting the claims in this instance, on account of their reference to, and dependence, on the drawings. The first section is limited to the employment of flues in the ends of the oven, communicating with the space in double oven doors, by means of valves which close the connexion when the doors are open, in combination with an arrangement of dampers for directing the draught around any part of the stove. The second section is limited to the employment of air chambers in front of the valves or dampers, which direct the draught under the boilers, for the purpose of protecting them from the intense action of the fire. And the third section is limited to the employment of a damper, or hinged partition, in the flue under the boilers, and placed in the middle thereof, and longitudinally, for the purpose of confining the heat to one set of boilers only.

11. For a *Safety Car, for Ascending and Descending the Inclined Planes of Railroads;* John Tittle, Johnstown, Pennsylvania, February 10.

This is a car which is to be placed forward of the train in descending, and back of it in ascending. It consists of a frame, one end of which is connected with the axle of a pair of wheels by means of a spring, the sides of the frame being formed like brakes, to gripe the tread of the wheels when borne down by the weight of a descending car, which, when separated from the locomotive, or other machinery, runs on the sides of the frame that rest and run on the rails, and are wedge-formed for that purpose, and thus the frame is forced down on to the wheels, which chucks them.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the construction of the body of the safety car, as aforesaid, in combination with the supporting wheels, axle, and spring, arranged and operating in the manner and for the purpose set forth."

12. For an *Improvement in Dressing Mill Stones;* Elisha S. Snyder, Charlestown, Jefferson county, Virginia, February 10.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the before described mode of dressing millstones, that is to say in ridges and furrows tangential to the eye, each furrow gradually *increasing* in *width* and *depth*, from the eye to the circumference, being of a triangular shape in its vertical cross section, and every alternate ridge being omitted from the eye to the circle, forming large triangular cavities for the admission of the grain to be broken, preparatory to its passing to the long furrows, to be ground into flour."

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13. For an *Improvement in the Condensing and Feeding Apparatus of Steam Engines;* Joseph P. Pierson, Jr., New York, February 10.

The patentee says,—"The nature of my invention consists in a refrigerating apparatus attached to the cylinder of the steam engine, wherein the water for condensation and the condensed steam are so distributed that a constant supply of fresh water is returned to the boilers, and also of cold water, for the condensation of its steam."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the refrigerator, as herein described, in combination with any of the known jet condensers—the said refrigerator receiving that portion of the water from the condenser which is not immediately returned to the boiler, cooling the same sufficiently for use in condensing, and returning it to the jet for the condensation of the steam from the cylinder; the whole being combined and operating substantially as set forth."

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14. For an *Improvement in the Straw Cutter;* I. J. Richardson, New York, February 10.

In this machine the straw is fed in through a vertical hopper, and rests on a board below, which receives a vibratory motion, up and down, from a cam on the crank shaft. The two knives are of a triangular form, the point of one corresponding with the cavity of the other, and these are attached to a horizontally sliding gate, to cut the ends of the straw resting on the feed-board, and projected below their plane of motion.

Claim.—"What I claim and wish to secure by letters patent, is the use of two triangular edged knives, combined in a straw-cutting machine, operated substantially in the manner above described.

"I also claim the manner of combining the feed-board, or gauge, with the straw cutter, substantially as above described."

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15. For an *Improvement in the Machine for Sowing Grain;* Wm. J. Jones & H. C. Smith, Fairfield, Connecticut, February 20.

In this machine there is a horizontal roller running in the opening at the bottom of the hopper, which roller is provided with recesses or cups to receive and measure the quantity of grain or manure to be carried out, and by its revolution the contents of these cups are delivered to the action of another roller parallel with it, and provided with pins, which scatters the seeds, &c.

Claim.—" We do not claim to have invented any of the parts above described, each taken separately being well known. But we do claim as new, and of our invention, and desire to secure by letters patent, the application of mortices and boxes, or cups, in the feeding roller, to measure off any proportionate quantity of seed or manure for deposite in any given surface of ground, in combination with the scattering roller, fitted with pins or beaters, when such application and combination is employed for the purposes herein set forth, and constructed and operating substantially as herein described and shown."

16. For *Improvements in the Filter;* Wm. H. Jennison, New York, February 20.

The objects of these improvements are to afford a more perfect and ready means of cleansing, and a more simple and effective filter, by constructing the case of the filter with two chambers, so arranged that it can be reversed and have either end attached to the pipe which delivers the water or other liquid to be filtered, and filtering through a conical bag of felted, or other cloth, so connected with the case that, when the apparatus or the direction of the water is reversed, it shall be turned inside out, the better to insure the delivery of the deposit.

Claim.—" What I claim as my invention and desire to secure by letters patent, is making the double case containing the filtering medium so that it can be reversed, substantially as herein described, to admit of the ready discharge of the impurities previously deposited, as herein described. And I also claim the employment, for the purposes of filtering, of a cone of felt, or other porous substance, to play within two chambers, substantially as herein described, so that by either reversing the whole apparatus, or the direction of the flow of the water, or other liquid, the cone shall be reversed, to admit of the more ready discharge of the impurities from its pores, as described."

17. For an *Improvement in the Mortising Machine;* Benjamin H. Otis, Dedham, Massachusetts, February 20.

On the sliding chisel rod there is a helical spring to raise the chisel, and this rod is connected with a collar at the top, that is attached to the connecting rod of the treadle or lever, and in this collar the rod can be turned, so as to present the face of the chisel in different directions.

Claim.—" What I claim as my invention and desire to have secured to me by letters patent, is the combination of the loose collar and fast collar, arranged at the top of the chisel rod, and having notches and studs, or teeth, respectively, as described, *with the spiral spring on which the said chisel rod is supported*, so that the *same* spiral spring which retracts the chisel, (by the combination above stated,) allows or provides for the turning round of the chisel ninety degrees, for the purpose and in the manner set forth."

18. For an *Improvement in the Safety Valve;* John Shorb, Canton, Ohio, February 20.

The object of this improvement is to prevent the adhesion of the main valve, by means of another valve, the lifting of which elevates a lever connected with the main valve.

We are under the necessity of omitting the claim, as it refers to, and is wholly dependent on, the drawings.

19. For an *Improved Method of Making Candles;* John Drummond, New York, February 20.

The nature of this invention consists in forming candles of tallow, (or other concrete fats) by forcing it, in the liquid or solid state, through a tube, and around the wicking, which is introduced through a small tube having its delivery end concentric with, and the upper end carried through, the side of the outer or forming tube, thus causing it (the tallow) to unite to the wicking and to be discharged from the lower end of the moulding tube, in a cylindrical form and in a solid state, so that it can be cut into the required lengths for candles.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of making candles by forcing the tallow or other suitable material, through a moulding tube, when this is combined with a small tube within it, through which the wicking is introduced, to cause the tallow to unite around the wicking, substantially as herein described."

20. For *Improvements in the Cooking Stove;* Rensselaer D. Granger, Albany, New York, February 20.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the draught tube, for admitting air to the fire, passing through the flue, in the manner described, by which the air admitted is heated before it reaches the fire.

"I also claim the mode of securing non-conducting substances, herein described, applied in a plastic state, and confined by ribs of metal or grating, as described and represented.

"I also claim the combination of the non-conducting substance forming the back of the oven, and serving the usual purpose of a brick oven for absorption, with the ascending pipes for heating the oven placed inside thereof."

21. For an *Improvement in the Machine for Cutting and Grinding Fodder;* J. Jessop, J. Wanbaugh, G. W. Ilgenfritz, and James C. Baker, New York, February 20.

The patentees say,—"The nature of our improvement consists in the manner of arranging the hopper and cylindrical grinders of a combined machine for cutting and grinding fodder, to prevent the mill from choking, a defect long since experienced and not removed in any of the machines heretofore made for this purpose, with which we are acquainted. In machines heretofore made for this purpose, the grinding cylinders are so placed as to receive the fodder from the cutters between the two cylinders, when two are used, or between the cylinder and concave, when only one cylinder is employed; but to prevent the choking of the mill, which frequently occurs in these arrangements, we discharge the fodder from the cutters into a hopper back of the main grinding cylinder, and in which it revolves, so that by its revolution, the teeth of the cylinder carry up and around, to be ground between it and the second grinding cylinder, the required quantity of fodder, so that the grinding is fed by the main grinding cylinder, instead of the cutting machine."

Claim.—"We do not claim as our invention the combination of grinding cylinders with a cutting machine, for cutting and grinding fodder; but what we do claim as our invention and desire to secure by letters patent, is the arrangement of the hopper back of the main grinding cylinder, in a combined machine for cutting and grinding fodder; so arranged as to cause the main grinding cylinder to take the fodder from the hopper, into which it is discharged by the cutters, and carry it around to be ground, or crushed, between the two, substantially as described."

List of American Patents which issued in the month of April, 1842, *with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

(Continued from page 40.)

40. For an *Improvement in Fastening Bedsteads;* David Ball, Sandy Hill, New York, April 16.

Claim.—"Having fully described the nature and operation of my bedstead fastening, what I claim therein as new, and desire to secure by letters patent, is the manner of forming the two parts marked (C) and (D), so that an offset on the former shall fit into a recess in the latter, and draw and bind the parts together by rotating the rail to which the parts (C C) are attached, said rail rotating upon pins which enter the posts in the manner set forth. I also claim the particular manner of fastening the head and foot boards by means of metallic clips, and the tongues and grooves, arranged and operating as described."

The pieces indicated in the claim by the letter C are made of metal, secured to the ends of the side rails, and are each provided with a tongue which, on partly rotating the rails, enter cavities in corresponding metal pieces (D) attached to the end rails.

The clips for securing the head and foot boards are metallic sockets attached to the posts, and having sharp projecting ridges inside, so that, when the boards are forced down into the sockets vertically, these ridges enter cavities in the wood and thus hold the posts together.

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41. For an *Improvement in Stop Cocks for Tapping Water Pipes, under Hydrostatic Pressure;* Jona Ridgway, New York, April 16.

At the end of that part of the pipe of a stop cock which is to be screwed into the water pipe there is a drill cutter which extends up the sides to cut the thread, so that the hole is bored and tapped, and the cock screwed in at the same operation to prevent the escape of water.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of a cutter with the stop cock or faucet made in any of the usual ways, in the manner and for the purpose herein described."

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42. For an *Improvement in Horse Shoes for the Cure of Hoof-Bound Horses;* Daniel Homer, Alton, Illinois, April 16.

The patentee says:—"This invention consists in turning the inner parts of the heel of the shoe upwards with the hoof of the animal, so that the shell or horny part thereof shall rest upon the inclined surface of the elevated portion, and thereby cause to open or spread the heel of the foot, which had become so contracted as to pinch and cramp the frog and create soreness and consequent lameness, which has been known and denominated *hoof-bound* disease or complaint.

Claim.—"The part I claim as new and as of my invention, is that peculiar shape of the heel or the part turned upwards into the foot, differing from anything I have ever known to be in use. A slight twist of the heels of shoes has been practised differing from my invention or improvement in effect as well as in shape, the latter producing a cure in a few days, whereas by the former it requires several shoeings and some months' time to remedy the complaint."

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43. For *Improvements in the Padlock;* William Ball, Washington, District of Columbia, April 16.

Claim.—"What I claim as my invention and desire to secure by letters patent, is

"1st, The principle of locking the shackle, or other similar article by counter weighted vibrating hooks, arranged in alternate order so as to prevent the lock being opened by a blow on the outside, whether constructed and applied in the manner before described, or in any other mode substantially the same.

"2nd, I likewise claim the mode of holding the end of the shackle in the cavity of the hook or tumbler, by means of the latch connected with said hook, and resting under and against the shoulder near the end of the shackle, as described.

"3rd, Likewise constructing the lock with a spring strap for catching or entrapping the key of the lock picker, whether constructed and arranged in the manner described, or in any other manner substantially the same; or whether applied to padlocks or other kinds of locks.

"4th, The inclined end of the shackle in combination with the inclined projection of the hook or tumbler, for the purpose and in the manner set forth."

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44. For *Improvements in Machinery for setting Logs on the Carriages of Saw Mills;* John Sheffield, Williamson, New York, April 16.

Without drawings we could not give a clearer indication of this apparatus than will be found in the claim, without going beyond our limits.

Claim.—"What I claim as my invention and desire to secure by letters patent, is, first, the method of setting the log for cutting thick or thin boards at pleasure as before described, by means of the aforesaid combination of hands, springs, vibrating crutch, connecting rods, knee, universal joints, and clapper, said hands acting on the toothed slide to which the log is dogged by the clapper striking against adjustable stubs attached to the frame work or timbers of the mill, arranged for various lengths of logs to be sawed. Second, Likewise the combination of the arm, axle, and lever with the vibrating crutch and hands for altering the movement of the slides to saw thick planks or thin boards, at pleasure, as described. Third, The mode of fastening the head block to the carriage by means of the jaws and wedges in the manner described."

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45. For *Improvements in Bedsteads for Invalids;* William Woolley, New York, April 16.

We are under the necessity of omitting the claim of this patent as it could not be understood without the drawings. It is limited to the combination and arrangement of levers and catches for elevating or depressing different parts of the frame on which the bed rests, to admit of placing the patient in any position desired. Bedsteads of this general character having long since been known and used, the claim is limited to the peculiar arrangement of parts for effecting this end.

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46. For an *Improvement in Chimney Caps;* Stephen M. Allen, Boston, Massachusetts, April 21.

Claim.—" Having thus fully described my invention, I shall claim —protecting the mouth or leeward end of the discharging pipe of a turning cowle by a hollow cone, the diameter of the base of which shall be somewhat larger than the diameter of the mouth of the discharging pipe; and I also claim the combination of the said cone with the conical air tubes arranged in the interior of the discharging pipe, the whole being constructed and operating substantially as above described."

47. For an *Improvement in the Cooking Stove;* John Brereton, New York, April 21.

The object and nature of this improvement will be clearly understood by the following

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination herein set forth as forming a heated air chamber, over, under, and around the cooking utensils, by the sliding doors, thereby retaining and confining the heat given from the grate below. The oven with the double bottom and other details herein given I do not claim."

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48. For an *Improvement in the Hydro-pneumatic Lamp;* Stephen S. Lee, Providence, Rhode Island, April 21.

This improvement is for drawing the oil from the lower reservoir of this class of lamps simply by means of a syphon, the outer and long leg of which turns on the other, and when turned down, forms a communication with the reservoir, and when turned up, closes it, to exclude the air.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the application of the syphon, or faucet, or other means substantially the same, to draw the oil from the chamber, and avoid the disagreeable and inconvenient necessity of inverting the lamp every time it is filled."

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49. For *Improvements in the Machine for Tempering Clay;* Rich. Stillman & Jesse Taylor, Philadelphia, Pennsylvania, April 21.

Claim.—"We do not claim to be the first who have used a tempering wheel, or wheels, made to traverse back and forth on a horizontal shaft; but we do claim to have made a material improvement in the construction of this apparatus, by combining and arranging the respective parts thereof, in the manner described; that is to say, we claim the forming of the iron wheel, with the curved spokes so attached to the hub and to the rim as to leave a space between them. We also claim the manner of causing a wheel, formed as described, to traverse back and forth on a horizontal shaft, by cutting intersecting right and left-handed screws on said shaft, and employing a swivel piece with the hub of the wheel, to take alternately into the threads of said screws, in the manner set forth. We do not claim the use of intersecting right and left-handed screws, in their general application, but only in their combination with a wheel for tempering clay, constructed and operating as herein made known, and actuated by animal or other power."

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50. For an *Improved Apparatus for Raising Sunken Vessels;* Theo. R. Timby, Auburn, New York, April 21.

The ship is to be raised by means of a vessel attached to it, and from which the water is to be expelled by pumping in air through the bottom, which is open, to receive the air and permit the escape of the water. These vessels are of a funnel shape, with the large end closed. Metal rods are attached to the top of the cap, (at the large end,) pass over a strong metal ring that surrounds the greatest diameter, and all of them are united with a large ring at the bottom.

Claim.—"I do not claim raising sunken bodies by forcing water out of a floating vessel by pumping air into it, but what I do claim, is the peculiar funnel shape of the air vessel, having a conical cap, over and around which the chains or other fastenings are secured, by which the air vessel is attached to the ship or body to be raised, as described, in combination with the manner of securing the chains, or rods, and passing them over the ring, so as not to injure the air vessel, as described."

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51. For an *Improvement in the Construction of Umbrellas, &c.;* Gilbert S. Ward, Newark, New Jersey, April 21.

This improvement is applied to that class of umbrellas, the rods or whalebones of which are jointed, to fold over; and the improvement consists in making one of the metal pieces of the joint with a projection, so as to form a support for the other part when the umbrella is opened, and at the same time protect the silk covering.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the whalebones of umbrellas and parasols with the supporting piece in combination with the joint, as herein set forth."

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52. For *Improvements in the Power Loom;* James Nield & Caleb Duxbury, Taunton, Massachusetts, April 21.

The claim of this patent refers to, and cannot be understood without, the drawings, the great size of which, and the necessary complexity of the mechanism, preclude the publication at present.

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53. For *Oiling the Spindles and Tubes of Cap Spinners;* Charles Danforth, Paterson, New Jersey, April 21.

Claim.—"I claim as my improvement a cavity in the top of the cap-top, to hold oil and prevent it from running down on the outside of the cap, in combination with a recess, or groove, between the cap-top and the spindle, to allow the oil to run down to the tube below, essentially as described in this specification."

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54. For an *Improvement in the Method of Driving the Spindles of the Danforth Cap Spinning Frame;* Charles Danforth, Paterson, New Jersey, April 21.

The spindles, or rather bobbins, are turned by bands running on to a horizontal drum, and the band must, of necessity, be at different elevations. The warves are attached to tubes having blocks projecting upwards, on which the bobbins rest, so that the lengths of these blocks will enable the constructor to have the bobbins all on the same level, and the warves at different elevations, to be on a line with the bands.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the tubes (on which warves are affixed, at different heights,) with the blocks or buttons placed thereon, for the purpose of supporting the bobbins at the same height; the whole constructed in the manner and for the purpose herein set forth."

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55. For an *Improvement in the Reaction Water Wheel;* L. W. & G. W. Blake, Pepperell, Massachusetts, April 21.

Claim.—"What we claim as new, and desire to secure by letters patent, is the placing of the buckets between two plates, so formed that the parts in which they are contained shall constitute the frustrums of cones, the lower or outer plate or plates being left open, for a central discharge between the buckets; said buckets being also so arranged as that their planes shall form a tangent, or nearly so, with a circle of said opening; such wheel or wheels being furnished with a neck, or collar, running truly within or against a metallic plate; and the respective parts of said wheel and its appendages being combined together, and arranged substantially as above set forth."

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56. For an *Improvement in the Waste Gate of Mills;* E. Eastlack & J. A. Miller, Greenwich, New Jersey, April 21.

The patentees say,—"The nature of our invention consists in applying a combination of buoys and levers, cords and pulleys, to waste and flood gates, in such a manner that the rise of the water over a medium or desired height, shall raise the gates and let the water escape, and thus prevent an overflow, or breaking of the dams or banks."

Claim.—"What we claim as our invention and desire to secure by letters patent, is the particular arrangement of the levers, in combination with the buoys, pulleys, cords, and gate, for the purpose herein specified."

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57. For an *Improvement in the Smut Machine;* James Durling, Sparta, New Jersey, April 21.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the smut machine with the scouring stones for flouring mills, as described, and for the purposes herein set forth; distinctly and expressly disclaiming all else."

BIBLIOGRAPHICAL NOTICE.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Report on the Survey of the Coast of the United States. By A. D. Bache, L.L. D., *Superintendent.*

We have received the annual report of the Superintendent of the Survey of the Coast of the United States. It is a clear and comprehensive document, of seventy-four pages, showing the progress of that important work, which is advancing in a manner creditable to those engaged in conducting it, and highly advantageous to the country.

No greater boon can be conferred upon American commerce than that of furnishing, at a low price, an ample supply of accurate charts of all our coasts and harbors. We have long been dependent upon old and incorrect maps, often derived from foreign sources, and frequent and fatal marine disasters have been the consequence; but this cause of disgrace to our country is now rapidly diminishing under the exertions of the present efficient administration of the coast survey.

During the past year, operations have been carried on in fourteen States, and the system introduced by Professor A. D. Bache, the present superintendent, of not waiting for the gradual extension of the triangulations of the survey from a single base line, but of carrying on, simultaneously, detached surveys of the most important parts of the coast, which are afterwards connected for mutual verification, has been most advantageously developed. This course of proceeding somewhat adds to the *annual* cost of the work, but it increases the useful results in a vastly greater proportion, and it has both common sense and true economy to recommend it. It may, and probably will, save many a gallant ship and many a valuable life, which otherwise would have been lost before the mapping of the coast had reached the shore on which they might have stranded.

What the mariner wants is accurate knowledge, his safety depends upon it, and yet he has no means of acquiring it for himself. Pilots hand down from father to son the traditions of the channels, rocks, and shoals, which they are supposed to understand, yet often very imperfectly. The labors of the coast survey have already resulted in discovering deep-water channels into the harbors of New York and Philadelphia, the existence of which was not known before. The positions of rocks and shoals and depth of water upon them have been accurately ascertained, and new ones discovered. A shoal off Nantucket has been discovered in the past year "six miles south of any known danger, lying directly in the usual track of vessels between New York and Europe, and in that often followed by coasting vessels between New England and New York, out of sight of land, unmarked and unknown except to the lost." Every one must feel the value of such a contribution to knowledge. The report is illustrated by nine engraved sketches, showing the progress of the survey, which serve to illustrate the text.

Throughout all the complicated operations connected with the work, from the measurement of the primary base line to the completion of the finished maps, there is required a combination of high scientific knowledge with practical skill, to an extent rarely called for in the execution of any work; and it is fortunate for the country that the Superintendent is a gentleman possessed of all the requisite qualifications for his difficult duties, and not only able to direct his assistants in all things, but always ready to give them, by name, the full credit of any meritorious service that they may render.

The maps which have been published are truly beautiful, and, as the plates can be multiplied to any extent by the electrotype process, they can be furnished in any quantity that may be required by the good of the country at whose expense the work is executed.

MECHANICS, PHYSICS, AND CHEMISTRY.

Extract from the Third Report upon the Action of Air and Water, whether fresh or salt, clear or foul, and of various Temperatures, upon Cast Iron, Wrought Iron, and Steel. By ROBT. MALLETT, Mem. Inst. C. E., M. R. I. A.

Conclusions drawn from discussing the results given in the tables, as regards Iron Ships.

Continued from page 133.

The next part of the process consists in covering the iron with the preservative alloy, which is to be prepared in the following manner: Zinc is to be melted in a suitable vessel, which is best of pottery or stone; and when in fusion mercury is to be added to it, in the proportion of 202 parts of mercury to 1292 parts of zinc, both by weight; that is, 40 atoms of zinc to 1 of mercury, or thereabouts. These are to be well stirred or mixed together with a rod of dry wood, or of iron coated with clay. To the above alloy is now to be added either potassium or sodium, in the proportion of one pound to every ton weight; the alloy of either will answer the purpose, but I prefer sodium, as more easily obtained and more manageable. These metals are usually preserved from oxidation in naphtha, or some other fluid not containing oxygen. They are to be removed from this in small portions, not more than half an ounce at a time, placed in a small inverted cup of wood formed on the end of a stick, and thrust rapidly below the surface of the alloy of zinc and mercury, with which either may be made thus to combine easily, and without loss or combustion of the alkaline metal. The triple alloy thus formed of zinc, mercury, and sodium or potassium, after having been again stirred and mixed with the dry wood rod, is ready for coating the prepared iron when immersed in it. The combination of these metals is facilitated, and their oxidation on the surface retarded, by strewing upon it some of the salts contained in solution in the "preparing bath" when in a dry state.

The plates of iron or other articles are now to be taken up out of the "preparing bath," permitted to drain for a few seconds, and immediately, while still wet with the liquor, immersed in the fused alloy; and as soon as they have acquired its temperature, which should not be raised higher than is necessary for fusion, they are to be withdrawn again edgewise, and will be found covered with a perfectly uniform and coherent coat or surface of the alloy.

The affinity of this alloy for iron is so intense, and the peculiar circumstances of surface induced by the preparing bath upon the iron presented to it are such, that care is requisite, lest, by too long an immersion, the plates or articles of iron should be partially dissolved; and where the articles to be covered are small, or their parts minute, it is necessary, before immersing them, to permit the alloy to dissolve or combine with some wrought iron, in order that its affinity for iron may be partially satisfied, and so this risk be avoided. The alloy will, at its proper fusing temperature, which is about 680° Fahr., dissolve a plate of wrought iron of an eighth of an inch thick in a few seconds, and form with it a quadruple alloy.

More or less mercury, and more or less of the alkaline metals may be used in forming this alloy, but the proportions given are those I have found best, as the alloy is permanent at its temperature of fusion; *i. e.*, no mercury is lost by volatilization, nor does the alloy show any inconvenient tendency to oxidation, much less indeed than common zinc does at the surface, which is, in the case of the alloy, to remain covered with any oxide produced, and with the dry salt, the double chloride of the preparing bath transferred to it on the pieces of iron, as these defend it from the action of the atmosphere. It is desirable that the melting vessels should be as deep, and expose as small a surface, as the nature of the articles to be immersed will allow. At the moment of immersion of a plate or other article of iron, the surface of the alloy is to be cleared of all dross or oxide by a wooden skimmer.

As soon as the iron is withdrawn from the alloy, it is to be plunged into cold water and well washed therein. The surface of the iron is now in a condition to resist corrosion.

By the addition of a larger portion of mercury to the before mentioned alloy of zinc, mercury, and sodium or potassium, cast or wrought iron, or steel, may be coated therewith at a lower temperature, or even cold, by simple contact accompanied with friction; but a smaller quantity of mercury than that before given, will often be found most convenient.

In the case of iron ships the foregoing operations are best performed upon the plates and ribs after they have been all bent and fitted to their places, and the plates riveted together into large pieces of eight to ten feet square, or more, which, when again put "into frame," or placed in their respective positions in the ship's hull, are to be united by rivèts countersunk from the outside, and hence closed inside the vessel.

The countersunk heads of these rivets should be also coated with the alloy; and I have mentioned in detail elsewhere how these may be heated for riveting without injuring the alloyed head.

The hull of the iron vessel being thus completed and wholly covered with the alloy, is now to receive a coat of varnish all over of the composition about to be described, and which is best laid on with a spatula, or thin flexible blade of iron, as a brush produces minute air-bubbles, which leave spaces uncovered on the drying of the varnish.

The varnishes described will dry, or get hard and coherent at ordinary temperatures, but where convenient, it is desirable to expose them for some hours to a temperature of about 300° Fahr., which gives them greater adhesion and durability.

To form the varnish No. 1, take 50 pounds of foreign asphaltum, melt and boil it in an iron vessel for three or four hours, adding gradually, in fine powder, 16 lbs. of red lead and litharge ground together in equal proportions, with ten imperial gallons of drying linseed oil; bring all to a boiling temperature, melt in a separate vessel 8 lbs. of gum anime, (which need not be of the clearest or best quality,) add to it two imperial gallons of drying linseed oil, boiling, and 12 lbs. of caoutchouc, softened or partially dissolved by coal-tar naphtha, (as practised by the makers of water-proof clothes;) mix all together in the former vessel, and boil gently until, on taking some of the varnish between two spatulas, it is found tough and ropy. When this "body" is quite cold, it may be thinned down with from thirty to thirty-five gallons imperial of turpentine, or of coal naphtha.

This is the best varnish I am acquainted with for the purpose of covering iron; it is not acted on, when dry and hard, by any moderately diluted acid or caustic alkali; it does not, by long immersion, combine with water, and form a white and partially soluble hydrate, as all merely resinous varnishes and all oil paints do, and it is so elastic that a plate covered with it may be bent several times without its peeling off; and lastly, it adheres so fast that nothing but a sharp-edged instrument will scratch it off the surface of iron.

The varnish No. 2 is of a cheaper sort, but not quite so good. Common coal or gas tar is to be boiled in an iron caldron, at so high a temperature that the smoke from it is of a yellow dun color, or the tar is to be caused to flow through red-hot iron tubes. The boiling is to be continued until the residue is a solid asphaltum, breaking with a pitchy fracture. It is essential that the boiling should be carried on at this high temperature, as the permanency of the varnish in water depends upon the tar having been submitted to the temperature at which naphthaline is formed by the decomposition or breaking up of the original constitution of the tar.

Take 56 lbs. of this coal-tar asphaltum, melt it in an iron vessel, add ten imperial gallons of drying linseed oil, ground with 25 lbs. of red lead and litharge in equal proportions; add to the whole, when well mixed, and after boiling together for two or three hours, 15 lbs. of caoutchouc, softened or partially dissolved by coal naphtha, (as before described;) when cold, mix with twenty to thirty gallons of turpentine or coal naphtha, and the varnish is ready for use.

Either of these varnishes is to be applied over the whole surface of the iron and suffered to dry; and as this forms the final preservative coat upon all articles except iron ships, buoys, &c., requiring to be preserved from "fouling," any desirable color may be given to it by coloring materials, which should be peroxides not acted on by air and water.

The last operation, viz. that to prevent "fouling," now remains to be performed upon ships, &c.; for this purpose a strong-bodied thick paint is to be made with drying linseed oil, red lead, and sulphate of barytes (or white lead may be used, but not so advantageously,) and a little turpentine. To every 100 lbs. of this paint, when mixed, is to be added 20 lbs., or thereabouts, of oxychloride of copper, and 3 lbs. of a mixture composed of hard yellow soap, melted with an equal weight of common resin and a little water.

The color sold in commerce originally under the name of Brunswick green was an oxychloride of copper. The Brunswick green of commerce at present is a different thing, but the oxychloride of copper may be obtained at a cheap rate by various known methods, which it is unnecessary to detail. With this paint the whole *immersed* hull of the vessel is to be coated over the before-mentioned varnish; it must then be permitted to dry and stiffen for three or four days before the ship is floated out of dock. The operations are now completed, and the hull of an iron ship so treated will resist "corrosion" and "fouling."

The principles upon which this method of protection rests may be thus stated:—By the use of the "preparing bath," the surface of iron, of whatever sort, is more effectually cleansed than has before been practicable, and all minute particles of foreign matter removed from the surface; and by the reactions which take place in the "preparing bath," in which *metallic amides* are formed, and hydrogen evolved at the surface of the iron, a powerful tendency is given to the iron to combine with other metals. Again, by the presence of the small quantity of sodium or potassium in the alloy, a greatly increased tendency to combine with iron is conferred upon *it*, while any minute portions of oxide, either suspended in the fluid alloy, or which have escaped the previous operations upon the surface of the iron, are reduced to metal. Thus both metals are presented to each other in a state of absolute purity, and in the most favorable circumstances for combination.

But further, when the alloy, or generally any alloy of mercury with metals electro-positive to it, is exposed to the action of a solvent, the positive metal at the surface is first acted on, and the surface becomes shortly covered with pure mercury. The result, therefore, of the primary reaction of air and water on this alloy is, that the coating of the iron becomes covered with a very thin film of *amalgamated zinc*, which is known not to be acted on by fluid menstrua, except under peculiar conditions. I found no calcareous coating formed on such a surface in sea or fresh water. The varnish laid over this is intended as a sheathing, to give additional durability and mechanical protection;

and also in the case of iron ships, to interpose between the covering of alloy and the final coat of poisonous paint.

It was stated by Sir H. Davy, in his researches on the preservation of copper sheathing, that the sole cause why it did not become "foul" when unprotected was, the continual loss of substance by solution and washing away of the salts produced (the suboxide and oxychloride of copper,) and that the poisonous properties of the salts produced had nothing to do with the matter. The only proof, however, given of this was, that fouling rapidly took place upon a surface of *lead* forming a portion of a coppered vessel's hull, upon which there existed an abundant production of carbonate of lead. Although fully aware of the powers of endurance possessed by the classes of animals which adhere to ships, such as those of the genera *Balanus, Otion, Ascidia, Cineras, Anatifa, Ostrea, Mytilus, Dreissena,* &c., still I doubted this conclusion, from remarking that they adhered to the surface of metals, such as zinc in a rapid state of degradation or solution in sea water, but which did not produce poisonous salts.

I also observed, that to perfectly clean metallic surfaces they showed little disposition to adhere; that either a thin coat of peroxide, or of calcareous matter deposited from the sea water, was necessary to their adherence; that the testaceous animals seemed to disregard the nature of the metal to which they clung, provided they had a coating of calcareous matter to adhere to, and that the same applied to a great extent, to the growth of sea-weeds.

I thence determined to make some direct experiments upon the effects of metallic poisons upon such common molluscous or testaceous animals as I could command, and for this purpose I chose the common oyster, the limpet, *(Patella,)* and some of the *Actiniæ* found along the shores of Dublin bay; these were placed in glass vessels of sea water frequently renewed, and left for some time without disturbance, until it was certain that the condition of the animals was not in itself fatal or injurious to them. Then certain poisonous metallic salts were gradually introduced into their respective receptacles, such as the soluble and insoluble salts of lead, copper, mercury, arsenic, &c.

The results of these experiments, which were continued for a long time and made with care, showed that all these animals were more or less subject to annoyance from substances poisonous to the higher animals; that they were least affected by the salts of lead and mercury, and most so by those of copper; and that, unless present in such large quantity as to be at once fatal, the insoluble, or rather difficultly soluble, salts of copper in sea water, (such as the oxychlorides and the arsenite of copper,) gave them much more uneasiness than the soluble ones. The poisonous matter, when difficultly soluble, was sometimes merely dropped into the sea water near the animal, at others, was strewed upon a plate, and the animal placed upon it. In every case, when the animal was killed, the poisonous matter, (at least the copper, which was the only metal looked for,) could be detected in its body after death.

From these experiments, I think I am justified in concluding that the other classes of "fouling animals, whose habits are so analogous to those tried, are prevented from adhering to copper sheathing in virtue of the poisonous salts produced by the sea water acting upon it, and not merely by loss of continuity; and that in the case of the lead cited by Davy, the animals adherent must have been protected from the poisonous surface by a coat of calc-spar or carbonate of lime formed upon it, or by some other unexplained circumstance; and that hence the production of an artificial poisonous surface upon the bottom of an iron ship, a buoy, &c., would prevent their "fouling" also.

I also made some experiments upon the effect of metallic poisons upon sea-weeds, choosing for this purpose portions of *Fuci* adherent to small loose pebbles, and thus capable of transfer to a glass vessel. The results here were not so distinct as with the animals, but proved that copper salts in solution were decidedly deleterious to their existence. I ascertained also that marine plants would with the greatest difficulty attach or grow upon greasy or varnished substances free from any film of calcareous matter or oxide of iron.

From these experiments, I have been led to propose the peculiar poisonous paint, already described, as a preventative to "fouling" of iron ships; it is in fact a method of bringing their immersed surfaces as nearly as possible to the condition of a copper-sheathed vessel, without injury to the iron. The paint, therefore, is only a vehicle for poisonous matter, for which purpose it is requisite that it should have sufficient adhesion to resist the ship's motion, but still should have a slight degree of solubility in water, so that the poisonous matter may be taken up by the absorbent or capillary vessels of an adhering animal or plant. This latter property is given it by the addition of the resinous soap, the proportion of which must be varied to suit frigid or tropical climates. I prefer using the oxychloride of copper as the poisonous matter of this paint; indeed it is simply the formation of this salt that prevents "fouling" of ordinary copper sheathing, but other salts will answer the purpose.

The cost of protecting, by the methods described, the hull of an iron ship, of say 130 feet keel, materials and labor included, and preparing her against fouling, would add about ten shillings per ton to the cost of her hull, an amount quite inconsiderable when balanced against durability, safety, and speed.

When no attempt is made to procure complete protection from corrosion, a considerable palliative consists in heating all the plates before being put together to nearly a "black-red" heat, in a boiler-maker's oven, immediately plunging them into boiled coal tar, and taking them out while still warm, so that a firm varnish may form upon them; but spots of rust soon appear even upon plates so treated.

It is very desirable in every iron ship, that a layer of felt saturated in coal tar, boiled to the consistence nearly of pitch, should be interposed between not only every metallic body electro-negative to iron, as before observed, but also between *every* piece of timber, of whatever sort, placed in contact with the hull below the water-line, and most especially in the bilge. Besides obvious mechanical reasons, this is important from the fact that as soon as timber begins to decay in contact with iron and sea water, the rotten wood possesses the power of decomposing the sulphate of lime of the sea water, reducing it to sulphuret, while carbonic acid evolved from the decayed timber again decomposes the latter, producing sulphuretted hydrogen, which corrodes the iron locally with great rapidity.

Soft wood not only rots soonest, but decays in a way that produces these effects more rapidly than the harder timber; this fact I would press upon the attention of iron ship-builders.

These remarks might be extended, with many others of importance to the practical constructor, but for which this is not the place.

In conclusion, when the durability of iron vessels, as regards corrosion, and this is admitted alone to limit their existence, is compared with that of timber ships in reference to their decay, the balance undoubtedly seems at first in favor of the latter. We have examples of ships, such as the Royal William, built in 1719, lasting more than one hundred years; the Sovereign of the Seas, built in 1639, forty-seven years; the Barfleur, built in 1768, more than forty-four years, &c.; but these are the rare exceptions, not the rule.

The Commissioners of Woods and Forests, in their "Report of 1812, on Timber for the Navy," estimated the average duration of a ship at fourteen years, while other authorities take it at twelve and a half years. Frigates, when built of American red pine, seldom lasted longer than five years, and the Ocean, Foudroyant, St. Domingo, Rodney, Ajax, and Albion, new ships, all fell to pieces from dry rot in about four years.

Were it the fact, therefore, that unprotected iron vessels corroded equally throughout every part immersed, we could easily calculate, by the aid of our preceding researches, the durability of a ship of given scantling and predetermine, under such and such conditions, at what time her hull would have become dangerously thin, and might rest with the assurance that for this period the iron ship was the best and safest that could be put upon the waters; but unfortunately we have found that corrosion does not take place with perfect uniformity, as has been already pointed out; and hence, without protection, ships of iron must be always liable to the dangerous consequences of local corrosion and consequent thinning down of iron at particular spots, until, at some unforeseen moment, possibly of least preparation and greatest external peril, a decayed plate is burst through and the vessel fills. The facility of introduction of water-tight bulk heads in iron ships greatly reduces the danger of such an accident, but it must always be attended with danger and loss of property, and occurring where it is most likely to happen, namely, in the engine compartment of an iron steamer in bad weather, would be almost certain to involve the loss of the ship.

The more sanguine advocates of iron ship-building have, in their anxiety to prove their durability to be such as to render protection needless, appealed to the existence of iron canal boats of 40 years of age or more, and to some of the earliest built iron vessels, which have been occasionally in salt water. Most of the vessels alluded to, however, have been principally in fresh water, and on referring to Table XV, it will be obvious how vast a difference there is in the durability of a ship of any given sort of iron, exposed to the action of sea and of fresh water. Thus, suppose a vessel of Low Moor plates; in one century the depth of corrosion would be—

	Inch.
In clear sea water, . .	0·215
In foul sea water, . .	0·404
In clear fresh water only, .	0·035

In other words, while the ship, if originally of half-inch plates, would be almost destroyed in foul sea water, it would not have lost one-tenth of its scantling, in clear fresh water in the same time. These cases, therefore prove nothing to the point.

It therefore seems to me that protection against local corrosion and "fouling" is essential to the safety and perfection of iron ships, and is alone wanting to render our future iron ships as much safer and more enduring than those of timber, as the steam ship of to-day is safer and more enduring than the sailing vessel of two centuries ago.

The mechanical methods which have been proposed for removing foulness from the bottoms of iron ships, namely by scraping with a large wooden frame drawn under the hull by suitable rope tackle, appears quite incapable of removing more than the mere exterior fringe as it were, of the "foulness," or some of the larger animals when once become adherent. The force with which both animals and plants adhere to the coat of calcareous and rusty matter on an iron plate is very great, and no instrument sufficiently sharp, and pressed hard enough to the ship's hull, could probably be successfully used, unless of iron, and this would be liable not only to injure the surface, but become constantly caught against small projections of the ship's bottom.

But even were some methods of scraping possible, it only temporarily removes the evil, leaving its cause untouched; and that this cause is in such rapid operation, at least in some localities, as to be a most serious evil, may be illustrated by the following observations:—

Stevenson, in his account of the Bell Rock Lighthouse, mentions that the bottom of the temporary light-ship, after being newly caulked and pitched, was found covered over with mussels *(Mytili)* three and a half inches long, in three years and seven months from the time she was moored off the Bell Rock.

It is stated in the transactions of the Wernerian Society, vol. ii, p. 243, that the spawn of the Cirrhipoda class of fouling animals became developed upon a *feather*, on which it lay before the latter had decayed in sea water, and that they will cover a ship's bottom in a few months.

These observations apply to wooden vessels, and the prevalent opinion seems to be, that iron ships "foul" even more rapidly than these do in similar circumstances.

The opinion that iron vessels, as well as railway bars, receive some hidden power of resisting corrosion when in use, which they lose at other times, has been before alluded to.

The origin of this view with respect to rails is obscure. Wood, in his "Treatise upon Railways," quotes a Report of Mr. G. Stephenson, in which the following passage occurs:—

"One phenomenon in the difference of the tendency to rust between wrought iron laid down as rails and subjected to continual motion by the passage of the carriages over them, and bars of the same material either standing upright, or laid down without being used at all, is very extraordinary.

"A railway bar of wrought iron laid carelessly upon the ground, alongside of one in the railway in use, shows the effect of rusting in a very distinct manner; the former will be continually throwing off scales of oxidated iron, while the latter is scarcely at all affected."

This is the first notice I have found of this opinion, which has since been repeated in various quarters, but *no fact*, that I am aware of, has been given to support the view which a mere casual inspection of rails so situated suggests.

When rails lying parallel on the same line of way, but one set in and the other out of use are examined, appearances do undoubtedly seem to support the opinion. The unused rails are found covered with red rust, often coming off in scales parallel to the surface, while those in use present a light brown or buffish coat of rust, without any loose scales. I am much disposed, however, to believe that there is no real difference in the amount of corrosion in the two cases, and that the difference in appearance arises partly from a *deceptio visus*, by the effect of the bright and polished upper face of the used rail, (kept so by constant traffic) contrasted with the rusty face of the unused rail, and partly from the fact that, as fast as rust is formed upon the rail in use, it is shaken off by the vibration of passing trains, and blown away by the draught of wind which accompanies their motion, and that the rail is soiled and partially blackened by coke, and other dust, &c.

Recently the assumed difference in rate of corrosion has received a new version; it has been stated that rails in use *do* corrode, as well as those out of use, provided the traffic pass over them in both, that is, in opposite directions, as on a single line of way, but do not corrode, if the traffic be confined to one direction. These results have been attributed to some undescribed and occult magnetic action.

Whether either or any of these views be correct or not, I am unable at present to say, but as the subject is not only interesting in a scientific point of view, but of practical importance, and as no correct measures as yet exist, or at least have been published, of the amount of loss of metal by oxidation and abrasion of railway bars, I have thought it desirable to institute some experiments to determine, first, whether there be any difference in the amount of corrosion of rails in and out of use; secondly, if there be any, to discover on what the effect depends; thirdly, to distinguish numerically between the loss due to corrosion, and that due to abrasion by traffic.

These experiments I have been enabled to commence on the Dublin and Kingstown railway, by the favor of the directors of that line, and hope soon to have others in operation upon the Ulster railway, which is a single line, with traffic, of course, in both directions over the same rails. I have not, as yet, obtained any results (from insufficient lapse of time,) which I can consider trustworthy, but so far I have not been able to recognize any distinct difference of corrosion between the used and unused rails; on a future occasion, however, I hope to be able to lay my results fully before the Association.

With this exception, and a few others merely of scientific interest, the present Report completes the investigation of all the more important practical desiderata on the subject of the corrosion of iron, &c., entrusted to me by the British Association, and I hope that as the information obtained by its liberal assistance becomes more known, it will be found of practical use by all who are engaged in the constructive use of iron, the substance perhaps the most valuable and important of all those with which Providence has endowed us.

Note by the Author.—Since the preceding Report was sent to press, I have learnt with satisfaction that the principles therein developed for preventing the fouling of iron ships, have been already acted on; that the Iron Queen and the Ben Ledi iron steamer have been coated with a composition of tallow, bright varnish, arsenic, and, I believe, sulphur, and that in the former case all fouling was prevented; and after the vessel had made two voyages to the tropics, she was found perfectly clean when docked on her return.

From the bottom of the Ben Ledi ten tons weight of mussels and barnacles are stated to have been removed previous to the application of the above poisonous varnish, which, although different from that I have recommended, not so efficacious, and not harmless as regards its reaction upon the iron hull, is still quite identical in principle with mine. R. M.

June 26, 1843. [Trans. of British Assoc.—Civ. Eng. & Arch. Journ.

On certain improvements in the Construction and Supply of the Hydro-oxygen Blowpipe, by which Rhodium, Iridium, or the Osmiuret of Iridium, also Platinum in the large way, have been fused. By Robert Hare, M. D., Professor of Chemistry in the University of Pennsylvania.

While a pupil of my predecessor, Dr. Woodhouse, in the year 1801, having observed that a jet of hydrogen when inflamed in atmospheric air, of which only one-fifth is oxygen, was productive of a heat of pre-eminent intensity, I was led to infer that in combining with pure oxygen, the gas, in question, ought to produce a temperature at least five times as great. This led to the contrivance of two modes of producing a jet consisting of a mixture of hydrogen with oxygen. Agreeably to one mode, the gaseous currents meeting like the branches of a river, were made analogously to form a common stream. This object was accomplished by means of perforations drilled in a conical frustrum of pure silver, so as to converge until met by another shorter perforation, commencing at the opposite surface, and so extended as to join them at the point of their meeting. The other mode was that of causing one tube to be within another, so as to be concentric; the outer tube being a little the longer of the two, the latter being employed for hydrogen, the former for oxygen.

In the year 1814, this last mentioned mode was improved, so as to have the means of securing, by adjusting screws, the concentricity of the tubes, and varying the distance of the orifice of efflux of the inner tube from that of the other.

The constructions employed in 1801, were described and published in a pamphlet, and afterwards republished in Tillock's Philosophical Magazine, vol. xiv., and in Annales de Chymie, vol. xlv. At the same time an account was given of the fusion of pure lime and magnesia, and of the fusion of platinum. Subsequently in a paper published in the Transactions of the American Philosophical Society, it was mentioned that I had volatilized platinum.

About the year 1811, Professor Silliman, in a memoir read before the Connecticut Academy of Sciences, gave an account of a series of experiments, in which the experiments which I had performed were repeated, and many additional fusions made. I had adverted to the intensity of the light produced during the exposure of lime to the flame. Alluding to the heat and light, my words were "the eyes could not sustain the one, nor the most refractory substances resist the other." The intensity of the light was still more insisted upon by Silliman.

My experiments were also repeated by Mr. Rubens Peale, during many successive years, at the Philadelphia Museum, for the amusement of visitors.

About the year 1813-14, it was ascertained, at the laboratory of Dr. Parrish, that a bladder being supplied with a mixture of hydrogen and oxygen, in due proportion, and punctured by a pin, while subjected to compression, on igniting the resulting jet, the gas within the bladder did not explode. Of course a burning jet of flame thus created, was found competent to produce, while it lasted, the same effect as when otherwise generated by the same gaseous mixture.

Soon after this result was obtained, Sir Humphrey Davy discovered, that if a lamp flame be completely surrounded by a gauze of fine wire, it may be introduced into an inflammable gaseous mixture without causing it to explode. This was ascribed to the refrigerating influence of the metal, keeping the gaseous mixture below the temperature requisite for inflammation. Hence it was inferred, that if a mixture of hydrogen and oxygen, while condensed within a suitable receiver, were allowed to escape through a capillary metallic tube, so as to form a jet, this might be made to burn without communicating ignition to the portion remaining in the receiver.

By means of an apparatus contrived agreeably to this idea, Dr. Clark of Cambridge, England, repeated the experiments, made many years before by Silliman and myself, without any other reference to ours, than such as was of a nature to do injustice. An exposition of the invalidity of Dr. Clark's pretensions to originality was made in

Silliman's Journal for 1820, vol. ii., and in Tillock's Philosophical Magazine, for 1821, vol. lvii.

The light produced by the hydro-oxygen flame with lime having been observed by Lieutenant Drummond, of the British Navy, was ingeniously proposed by him, as the mean of illumination in light houses, and has been, in consequence, subsequently used as a substitute for the solar rays, in an instrument known as the hydro-oxygen microscope, which is a modification of that which has been called the solar microscope. The name of Drummond light has consequently been given to a mode of illumination, which I originally produced as above stated.

The instrument which was used by Professor Silliman and by Rubens Peale, was that above described as having two perforations meeting in one. In this form it was, I believe, employed by Dr. Hope, of Edinburgh, and Dr. Thompson of Glasgow, who both treated it as my contrivance, anteriorly to the publication of Dr. Clark's memoir.

The other form, consisting of two concentric pipes, was modified by a Mr. Mangham, with the view of producing a lime light for the microscope above alluded to. When I saw Mr. Mangham at the Adelaide gallery in 1836, he treated this instrument as mine, in another form. I was surprised afterwards to learn that he had obtained a premium for this modification from the British Society for the Encouragement of Arts, without any allusion to the original inventor.

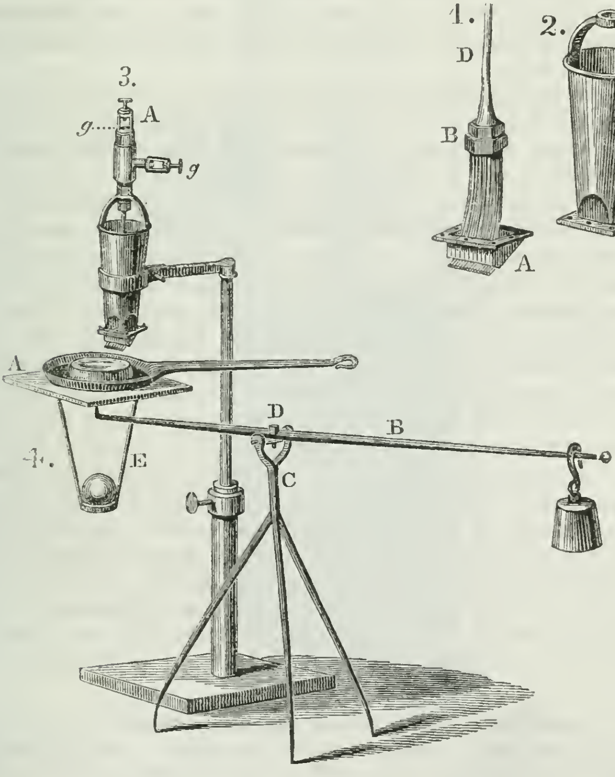
After my return from Europe in 1836, I was very much in want of a piece of platinum of a certain weight, while many more scraps than were adequate to form such a piece were in my possession. This induced new efforts to extend the power of my blowpipe; and after many experiments, I succeeded so as to fuse twenty-eight ounces of platinum into one mass.

Although small lumps of platinum had been fused by many operators, with the hydro-oxygen blowpipe, as well as myself, it had not, up to the year 1837, been found sufficiently competent to enable artists to resort to this process. I am informed by Mr. Saxton, that some efforts which were made while he was in London were so little successful, that the project was abandoned. There was an impression that the metal was rendered less malleable when fused upon charcoal, as in the experiments alluded to. This is contradicted by my experiments, agreeably to which fused platinum is as malleable as the best specimens obtained by the Wollaston process, and is less liable to flake. The celebrated Dr. Ure, on seeing the platinum in the forms of wire, of leaf, and plate, said that there was no one in Europe who could fuse platinum in such masses. He also alleged that it had been found so difficult to weld platinum, that no resort was had to that process. In this I concur, having had the welding tried by a skilful smith, both with a forge heat, and with a heat given by the hydro-oxygen blowpipe. An incorporation of two ingots was effected on their being hammered together, when heated nearly to fusion; but on hammering the resulting mass cold, a separation took place along the joint by which the ingots were united.

The difficulty seems to arise from the rapidity with which the platinum becomes refrigerated. It seems to have a less capacity for heat than iron, and, not burning in the air as iron does, has not the benefit of the heat acquired by iron from its own combustion with atmospheric oxygen.

Latterly, by means of the instrument and process which it is my object here to describe, I have been enabled to obtain malleable platinum from the ore directly, by the continued application of the flame. From some specimens of platinum I have procured as much as ninety per cent. of malleable metal. The malleability is not inferior to that of the best specimens obtained, by reducing it to the state of sponge, through the agency of aqua regia and sal ammoniac. There is, however, a greater liability to tarnish, arising, probably, from the presence of a minute portion of palladium.

Of the fusion of iridium and rhodium, I have already given an account in the Bulletin of the Society, which was subsequently embodied in an article prepared for Silliman's Journal for October last, 1846.*



It remains now to give an account of the apparatus employed in the fusion of platina on a large scale.

Fig. 1 represents the association of fifteen jet pipes of platina with one large pipe, B, D, at their upper ends, so that their bores communicate, by means of an appropriate brass casting, with that of the large pipe, the joints secured by hard solder. Their lower extremities are made to protrude about half an inch from a box, A, of cast brass, their junctures, with the appropriate perforations severally made for them, being secured by silver solder. They come out obliquely in a line along one corner of the box, an interval of about a quarter of an inch alternating with each orifice. By means of flanges, the brass box is secured to a conical frustrum of copper, fig. 2, so as to form the bottom thereof, while the pipe, extending above the copper case, is screwed to a hollow cylinder of brass, A, fig. 3, provided with two nozzles and gallows screws, *g*, *g*, for the attachment of appropriate hollow knobs, to which pipes are soldered, proceeding from the reservoirs of oxygen and hydrogen. Cocks are interposed by which to regulate the emission of the gases in due proportion.

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* Since published in the Revue Scientifique at Paris.

In connecting the pipes conveying the gases with the brass cylinder, A, fig. 3, care should be taken to attach that conveying oxygen to the upper nozzle, while the other, conveying hydrogen, should be attached to the lower nozzle; since, by these means, their great difference in density, tends to promote admixture, which, evidently, it must be advantageous to effect.

The object of surrounding the jet pipes with water, by means of the copper box,* is to secure them against being heated to such a degree as to cause the flame to retrocede and burn within them, so as finally to explode within the cylinder, A, *g*, *g*, fig. 3. It is preferable to add ice or snow to the water, in order to prevent undue heat.

Fig. 4 represents a movable platform, A, of cast iron, wholly supported upon the point of the iron lever, D, B, which is curved towards the extremity under the platform, so as to point upwards, and to enter a small central conical cavity made for its reception. The lever is supported by a universal joint upon the fulcrum, C, so that by means of the sliding weight at one end, the platform and its appurtenances are counterpoised at the other. The platform is kept in a horizontal position by the cannon ball, supported in a sort of iron stirrup terminating in a ring, in which the ball is placed. Upon the platform is situated an iron pan with a handle, holding the brick, on a cavity in which, as already mentioned, the metal is supported. The apparatus being duly prepared, and connected with the supply pipes, the hydrogen is first allowed to escape, and then the oxygen, until the ignition has attained apparently a maximum. The accomplishment of this object may, of course, require the adjustment of either cock several times, especially where there is any decline in the pressure either of the one or the other gas in its appropriate reservoir.

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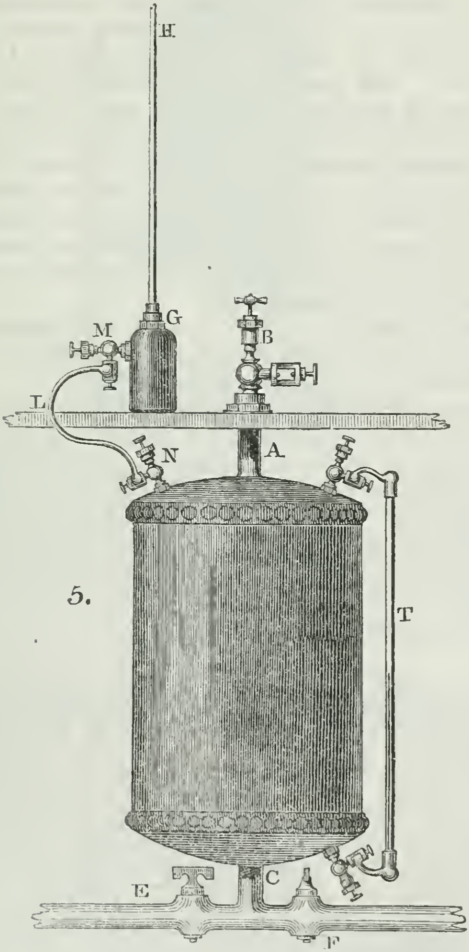
* Since the engraving was made, I have preferred to use water-tight boxes, with gallows screws and nozzles, situated one near the bottom on one side, the other on the opposite side near the top. By means of the lower nozzle, a pipe is attached, communicating with a head of cold water, the other being so situated as to carry the water into a waste pipe, or large tub, a circulation may be kept up during the whole time that the operation is going on.

As a support, a brick of kaolin is used, having an oblong elipsoidal depression on the upper face for the reception of the metal to be fused.

By means of the handles of the lever and of the pan, the operator is enabled to bring the metal into the position most favorable for the influence of the heat, while his hands and face are sufficiently remote to render the process supportable. In fusing any quantity, not being more than four ounces, the platform may be dispensed with, the handle of the pan being held in one hand of the operator, while by the other, the cocks may be adjusted.

When the blowpipe of fifteen jets, or any larger, may be employed, and the platform is necessarily resorted to, the cocks must be adjusted by an assistant.



5.

Fig. 5 represents a cask made of boiler iron, three-sixteenths of an inch thick, so as to resist an enormous pressure. The joints are secured by riveting, as in constructing high pressure boilers.

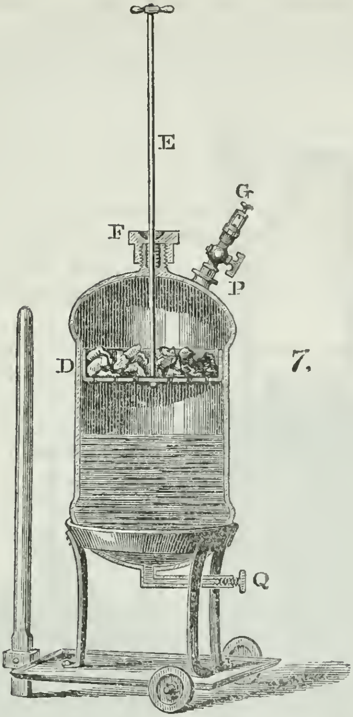
This cask communicates with the hydrant pipes, so called, by which our city is supplied with water, of which the pressure varies from a half to more than two atmospheres, say from seven to thirty pounds per square inch, according to the number and bore of the cocks from which the water may be flowing at the time, for the consumption of the community. Hence, experiments, while using this head, are best made towards bed-time, or between that time and sun-rise. The vessel is filled with water by opening a cock, F, on one side of the pipe C, and allowing the air to escape through the valve-cocks, B. Being thus supplied the cock, F, closed, and a communication with a bell glass, into which oxygen is proceeding from a generating apparatus, being made by means of a flexible leaden tube, on opening the valve cock, B, and the cock, E, the water will run out, and be replaced by gas from the bell. This process being continued till the iron cask is sufficiently supplied with gas, the cock, E, must be shut. Whenever the gas is wanted for the supply of the blowpipe, it is only necessary to establish a communication between the valve-cock, B, and the upper gallows screw, fig. 3, of the cylinder A, and to open the cock, F, so as to admit the water to press upon the gas, the efflux being regulated by B, or preferably by a cock of the ordinary construction, one of which kind should be interposed at a convenient position between the valve-cock, B, and cylinder A.

T, represents a glass tube, which, by due communication with the interior, shews the height of the water, and consequently the quantity of gas in the vessel.

G, H, represents a gauging apparatus, consisting of a cast iron flask, of about a half a pint in content, and a glass tube of about a quarter of an inch in bore, which should be at least five feet in height. The tube is secured air-tight into the neck of the flask, so as to reach nearly to the bottom within. The flask is nearly full of mercury. Under these circumstances, when a communication is made, by a leaden pipe between the cavity of the flask and that of the reservoir, an equilibrium of pressure resulting, the extent of the pressure is indicated by the rise of the mercury in the tube.

In order to generate hydrogen for the supply of a reservoir like that represented by the preceding figure, I have employed the vessel represented by fig. 7. This vessel, by means of a suitable aperture, susceptible of being closed by a screw plug, is half filled with diluted sulphuric acid. Being furnished with a tray of sheet copper, D, punctured like a coal sieve, and supported by a copper sliding rod, E, strips of zinc are introduced in quantity equal to the capacity of the tray. The sliding rod passes through a stuffing-box, F, at top of the reservoir, so that the operator may, by lowering or raising the tray, regulate or suspend the reaction between the zinc and its solvent, accordingly as the supply of hydrogen is to be produced, suspended, increased, or diminished.

The communication with the reservoir is opened and regulated by means of the cock, P, furnished with a gallows screw, G, for the attachment of a leaden pipe, as above described, in the process for supplying the reservoir with oxygen.



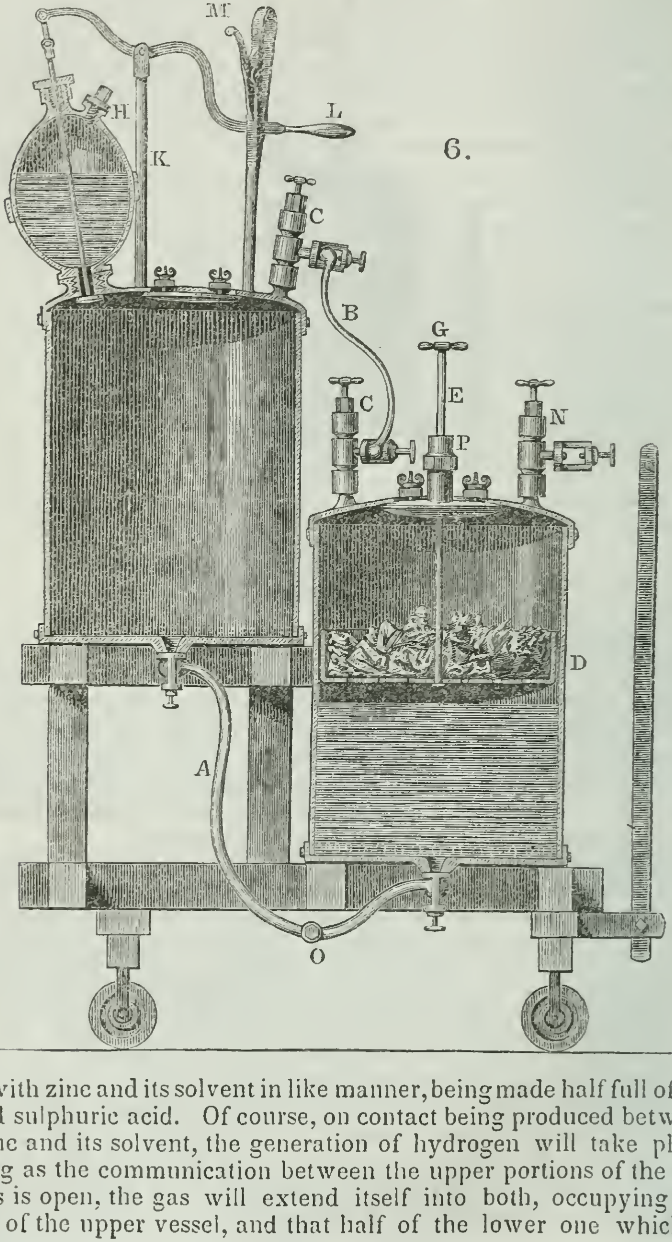
7.

Another apparatus for producing a supply of hydrogen, is represented in fig. 6. It consists of two similar vessels of boiler iron, each capable of holding forty gallons. They are lined internally with copper, being situated upon a wooden frame, so that the bottom of one is two-thirds as high as the top of the other. The upper portion of these vessels communicate by a leaden pipe, B, of about half an inch bore, furnished with a cock, while the lower portions communicate by another leaden pipe of a bore of 1½ inches.

The upper vessel is surmounted by a globular copper vessel, of about twelve inches in diameter, which, from its construction, renders it possible to introduce an additional supply of concentrated acid, while the apparatus is in operation, without reducing the pressure within the reservoir, by permitting the excess above the pressure of the atmosphere to escape. This object is accomplished as follows:—

The valve at the end of the rod, attached to the lever, L, being kept shut by the catch, M, the screw plug, H, removed, the acid is introduced through the aperture thus opened. In the next place, the plug being replaced, and the valve depressed by means of the lever and rod, so as no longer to close the opening, which it had occupied, the acid descends from the chamber into the cavity of the vessel beneath it. The valve is of course restored to its previous position as soon as the acid has effected its descent.

The lowermost vessel is furnished with a perforated copper tray, supported by a copper sliding rod, in a way quite analogous to that already described in the case of the copper reservoir. It is also supplied with zinc and its solvent in like manner, being made half full of the diluted sulphuric acid. Of course, on contact being produced between the zinc and its solvent, the generation of hydrogen will take place. So long as the communication between the upper portions of the two vessels is open, the gas will extend itself into both, occupying the whole of the upper vessel, and that half of the lower one which is



unoccupied by the liquid. But if, in this way, the pressure reaches to two atmospheres, as indicated by the gauge, on shutting the communication through the pipe B, the pressure in the inferior vessel will augment, that in the superior vessel remaining as before, but the liquid will consequently begin to pass out of the inferior vessel through the pipe A, and thus may lessen the contact between the acid and zinc, and finally suspend it altogether. Meanwhile the gas in the upper vessel being condensed to nearly half its previous bulk, the pressure will be nearly four atmospheres. It will, in fact, always be nearly double that which existed before the pipe, B, was closed.

In order that nearly the whole of the acid shall be expelled from the inferior vessel, the tray must be depressed till it touches the bottom of that vessel.

The pressure being four atmospheres at commencement, as soon as, by means of a pipe attached to the valve-cock, N, an escape of gas is allowed, the acid is forced again upon the zinc, and thus prevents a decline of pressure to any extent sufficiently to interfere with the process.

The gases may be used from a receiver in which they exist, in due proportion, safely by the following means:—

Two safety tubes are to be made, not by Hemming's process exactly, but as follows:

A copper tube, silver soldered, of which the metal is about the eighth of an inch in thickness, is stuffed with the finest copper wire, great care being taken to have the filaments straight and parallel. The tube is then to be subjected to the wire-drawing apparatus, so as to compress the tube on its contents until the draught becomes so hard, as that it cannot be pushed farther without annealing. The stuffed tube thus made is to be cut into segments, in lengths about equal to the diameter, by a fine saw. The surfaces of the sections are to be filed gently with a smooth file. By these means, they appear to the naked eye like the superficies of a solid metallic cylinder. Brass caps being fitted on these sections, they are to be interposed by soldering, at the distance of a foot or more, into the pipe for supplying the jet. Under these circumstances, the posterior section becoming hot, may allow the frame to retrocede; but the anterior section being beyond the reach of any possible combustion, and remaining cold, will not allow of the retrocession; and as soon as the flame passes the first section, the operator, being warned, will, of course, close the cock, and subject the posterior section to refrigeration before proceeding again.

But this plan of operating may be rendered still more secure by interposing a mercury bottle, or other suitable iron vessel, half full of oil of turpentine, between the reservoir and safety tubes, as in the arrangement of a Woulfe's bottle. A leaden pipe proceeding from the reservoir is, by a gallows screw, attached to an iron tube which descends into the bottle, so as that its orifice may be near the bottom. The leaden pipe communicating through the safety tubes with the jet-pipe, is attached to the neck of the bottle. Thus the gaseous mixture has to bubble through the oil of turpentine in order to proceed through the safety tubes to the jet-pipe. If, while this process is going on, the flame should, by retrocession, reach the cavity of the bottle, exploding in contact with the turpentine, a compound is formed, which is, *per se*, inexplosive from the excess of carbonaceous matter. Meanwhile the shock, acting on the surface of the oil, drives it into the bore of the iron tube, and thus, both by its chemical and mechanical influence, renders it utterly impossible that the flame should reach the cavity of the reservoir.

Improvement in the Pin Manufacture.

Pins are at present made for the most part of brass wire coated with tin to protect them from oxidation, for though pins have been also made, and may be still made for particular purposes, of iron and steel wire similarly coated, yet owing to the difficulty of coating the latter with tin, (arising from the small affinity which tin has for iron and steel,) it has been hitherto found impracticable to produce iron or steel pins of sufficient sharpness and smoothness to be suitable for general use, or applicable to any other than coarse fabrics.

A process has recently, however, been invented in France, and secured by patent in this country, (in the name of Mr. J. C. Robertson,) by which pins may now be manufactured of iron and steel equal to the best brass pins in point of smoothness, and far superior to them in respect of strength, sharpness, and tenacity.

The means by which this is effected may be described generally as consisting in giving the iron and steel pins a coating of copper previous to coating them with tin, the copper adhering readily to the iron or steel, for which it has naturally a strong affinity, and the tin combining with equal readiness with the superimposed copper; or in coating them with copper alone without any additional coating of tin.

The details of these improved methods of manufacturing pins of iron and steel wire, (so far as they differ from those of the methods hitherto pursued,) are described as follows, under the different heads into which the same practically divide themselves :—

The Selection and Preparation of the Wire.—The iron or steel wire employed should be very round, and, to protect it from rust, it should at the last drawing be lubricated by means of a sponge saturated with oil, placed between the draw-plate and reel. In all the subsequent stages of the manufacture care should also be taken to preserve the pins from oxidation by keeping them well oiled or greased.

The Cleansing and Polishing.—The wire being cut into pins, and these headed and pointed, all according to the usual methods, the pins are thrown into a revolving cylinder of wood, containing a bath of soap and water in a hot state. It is of the capacity of about nine gallons and a half, but should not contain more than about one gallon and a half of water, with about two ounces of soap dissolved therein, as this quantity will be sufficient for the treatment of about thirteen pounds and a half weight of pins at a time. The cylinder, when thus charged, is made to revolve for about a quarter of an hour; at the expiration of which time the pins are found free from the oil with which they were previously coated, and also very much smoothed and polished by their rubbing one against the other.

The Drying.—The pins are next dried by transferring them to another cylinder partially filled with well-dried sawdust, (preferring for the purpose the sawdust of poplar wood,) and causing this cylinder to revolve for about ten minutes; or, instead of employing a cylinder of this description, the pins may be thrown into a bag or bags partially filled with the sawdust, and the requisite friction produced by swinging or rolling these bags about for the same length of time.

The Copper Coating Bath or Mixture.—Into a glass, or stone vase, the inventor puts about one and a half gallons of soft water, seven-tenths of a pound of sulphuric acid, $\frac{6}{100}$ lb. of salt of tin, $\frac{8}{100}$ lb. of crystalized sulphate of zinc, and 108 grains of pure sulphate of copper, and leaves this mixture to work for about twenty-four hours, so that the salts and sulphates may be properly dissolved. This is found to be on the whole the mixture best adapted for the purpose in view; but most of the ingredients mentioned may have others substituted for them, as, for example, any other acid or substance producing like effects may be used instead of the sulphuric acid, or the sulphate of tin may be substituted for the salt of tin, or any of the salts of copper or zinc used in place of the sulphates of copper or zinc.

The Copper Coating Process.—The mixture prepared, as last directed, is introduced into another revolving cylinder, and pins (about 13½ lbs. weight as before) are thrown into the midst of it. The cylinder is then caused to revolve for about half an hour, which serves at once to remove any verdigris from the pins, to impart a high polish to them, and to give a beginning to the copper coating process. At the end of the half hour, or thereabouts, $231\frac{6}{10}$ grains (more or less) of crystalized sulphate of copper of about the roughness of marine salt, and $150\frac{2}{5}$ grains of crystalized sulphate of zinc, (previously dissolved in soft water,) are added to the mixture in the cylinder, and the whole again agitated for about a quarter of an hour. The pins are by this operation not only completely coated, but acquire a very considerable degree of polish. The copper liquor is then drawn off, and the pins twice suffused with cold water, while the cylinder is kept rotating at the rate of about one turn a minute. The pins are then taken out and thrown into a wooden tub containing hot soap and water, after which the tub is hermetically closed by putting on a rimmed cover, and making it fast by hooks and eyes. The pins are now well shaken, by overturning the tub and raising it up again, some thirty or forty times, more or less. The contents of the tub are then emptied into a wooden strainer having a perforated bottom of tinned plate iron; and when the soap and water has drained from the pins, the latter are placed, while yet wet, in a revolving cylinder, containing well-dried sawdust, (using by preference, as before, the sawdust of poplar wood,) or well-dried bran freed from flour. The pins are now dried by turning the cylinder for from five to six minutes, at the expiration of which time they exhibit a very beautiful copper appearance, and may be used in this state without tinning, if thought desirable.

A considerable portion of the coppering ingredients may be saved after each operation by allowing the mixture to settle, then drawing off the supernatant liquor, and adding thereto 386 grains of sulphuric acid to bring it up to a strength sufficient for subsequent use.

Tinning and Blanching.—The pins are tinned and blanched in the ordinary manner, and by the ordinary processes used for those of brass wire, that is, by laying them on plates of very thin tin placed one above another, in a tinned copper boiler containing a solution of about $4\frac{2}{5}$ lbs. of crude tartar, or cream of tartar, (preferring the latter,) in about twenty-two gallons of water, and then setting the whole to boil for about twelve hours. The tartar solution should be prepared at least twenty-four hours previously, and left to work for that time, in order that the ingredients may be thoroughly dissolved and intermixed. About $4\frac{2}{5}$ lbs. of cream of tartar is the minimum quantity which should be used, and the brilliancy and celerity of the tinning will increase in proportion to the increase of the quantity employed.

The pins are then taken out of the boiler and dried in a revolving cylinder or leathern bag, as before explained, after which they are ready for use. Lon. Mec. Mag.

Explosion of a Blast Pipe.

An explosion of a peculiar and unfortunately fatal nature, lately occurred at the works of Messrs. Losh, Wilson, and Bell, near Newcastle. It appears that one of the underground pipes of the blowing engine was in a leaky state, and the air thus escaping, forced its way into the ash-pit of one of the puddling furnaces near it. The carbonic oxide and carbonic acid gas thus generated, passed through to one of the offices connected with the establishment, and suffocated two of the workmen. Upon the discovery of this casualty, as the matter was undergoing an investigation, the blast regulator was exploded by a light carried by one of the men. This second accident caused the death of one man, and wounded several others. We subjoin the particulars of the case, as given by Mr. Bell, one of the partners of the firm.

"About half-past 6 o'clock, it was discovered that a man named David Davies, and a boy of the name of Spearman, were suffocated in an office constructed for the use of our workmen: and it was only after considerable difficuly, and great exposure to danger, that the bodies of these unfortunate individuals were extricated by the intrepid conduct of some of our men, where everything was done to endeavor to restore them to life, but in vain. To prevent the possible recurrence of such an accident, immediate measures were taken by the men to ascertain the cause of the disaster, with a view to its prompt removal; and then it was that it was ascertained, from some cause or other, that a joint of an underground pipe, of about four inches in diameter, communicating with our main blast-pipe, which is about three feet in diameter, had been leaking, and thus occasioning a loss of blast to a certain extent; which, making its way underground to the ash-pits of some of our puddling furnaces in its neighborhood, had caused a somewhat increased combustion of any ashes that might be, for the time being, lying under the bars. The heat thus generated had heated through the brick lining of the ash-pit, and communicated ignition to the small stratum of ashes on which the pavement is laid, as well as to a minute quantity of ashes that had got accidentally mixed with the clay, in the construction of the furnaces. The carbonic oxide and carbonic acid gases thus formed, had found vent by penetrating towards the office in which the deaths of Davies and Spearman occurred, and no doubt had suffocated them, as their bodies bore all the usual traces where asphyxia is the cause of death. The blast-engine being stopped, an endeavor was made to separate the four-inch pipe alluded to from the main blast-pipe; but this being impossible, or at least difficult, it was determined to proceed to the regulator (an iron vessel about 20 feet long and 6 feet diameter, shaped like a boiler,) where, by opening the manhole door, access might be had to the point of junction of the four-inch pipe with the main, and a secure stopping put in so as to prevent the possibility of any blast reaching the vicinity of the puddling furnaces or office. The manhole door being removed, William Short, the head smith of the establishment, and an intelligent man, smelling foul air, desired one of his assistants to keep off the opening with the lamp; which was done. In about three minutes, and while they were standing close to the regulator, Short heard a rushing noise in the blast-pipe and regulator; and instantaneously succeeding it, a terrific explosion took place, which threw him down. Fortunately he sustained only some very trifling injury; but Robert Rogers, a millwright, who was standing close to him, and immediately opposite to the manhole, was blown over a wall close behind them, in such a manner that to have reached his position the unfortunate man must have been projected very many yards into the air. He was so sadly mutilated that death must have been instantaneous. The explosion, following the main blast-pipe, was conducted by it to a supplementary blowing engine, great part of which it shattered to pieces: and one of the fragments of this, striking a young lad of the name of Maughan, dangerously fractured the bones of his face, and broke his arm: while another, taking a contrary direction, struck a man named Tyson, and fractured his leg. Robert Rogers is the only one among the killed who is married: and he, I regret to say, has left a wife and three children. The next morning, on visiting the scene of the accident, I was surprised to find how complete the destruction of the receiver had been; for of it not one-tenth remained on its seat, though it was very strongly held down. One large piece was thrown over all the offices (all the windows of which were blown-out); another was projected so high into the air, that on falling on some railing, 130 yards off, it was found impaled; a third was found on the top of the inn, 200 yards distant, at an elevation of 20 yards above its original level. Besides this, many yards of the blast-pipe were torn like so much paper; and fragments of it, and of the regulator, were found in various directions in the works. The cause of this deplorable explosion I take to be this: As soon as the manhole door was removed, a current of air has been put in motion along the main blast-pipe (owing, very probably, to the high wind blowing at the time), which had caused an influx of carbonic-oxide gas through the four-inch pipe from the puddling furnaces already mentioned; and this becoming mixed with the atmospheric air in the blast-pipe, would form a highly explosive mixture. How ignition was communicated, I cannot say; but I am of opinion that some red hot ashes in the ash-grates of the puddling furnaces is the probable source. It seems almost incredible that the comparatively small quantity of incandescent ashes should be able, in so short a time, to have generated sufficient carbonic oxide gas, and still more incredible that it should have entered in sufficient quantity into the blast-pipe to have caused such tremendous destruction as it did; but as all the blast-pipes in the vicinity of the blast-furnaces (the only other possible source of gas) are uninjured, I am compelled to come to the conclusion that the source I have mentioned was the true one of the explosion. Considering the quantity of material projected in various directions among our work-people, it is a miracle that many more were not sacrificed, I am glad to say, the injury (which will not exceed £200 or £300) is entirely among machinery not in present use, and will, therefore, not prevent our workmen following their usual avocations."

Glasgow Prac. Mec. & Eng. Mag.

On the Iron Manufacture of Great Britain.

Mr. G. R. Porter (of the Board of Trade) presented an elaborate report on this subject to the late meeting of the British Association, which he had prepared at their request. Having called attention to the enormous demand for iron consequent on the general and simultaneous construction of railways in England, on the Continent, and in India, he said it was important to consider how that demand may be met, and also how, on the cessation of that demand, which must be temporary to a great extent, the ruinous depreciation of capital and suspension of employment, consequent on the change, may be averted. In 1788, the whole quantity of pig-iron made in England and Wales, amounted to no more than 61,300 tons; of which 48,200 were made with coke of pit-coal, and 13,100 from charcoal; in the same year, the amount raised in Scotland was 7000 tons. In 1796, the quantity, owing to Watt's improvement of the steam engine, was nearly double, being—

England and Wales, . .	108,993 tons.
Scotland, . . .	16,086 "
Total, .	125,079 tons.

Ten years later—viz. in 1806—when it was proposed to tax the production of iron, an inquiry was made, and the production was found to have more than doubled in this decennial period, being—

England and Wales, . .	234,966 tons.
Scotland, . . .	23,240 “
Total, .	258,207 tons.

In 1823, the quantity had risen to 482,066 tons; and in 1830, it was further increased to 678,417 tons. But since 1830, in consequence of the introduction of the hot-blast by Mr. Neilson, of Glasgow, rapid improvements have been made, and a most important saving of fuel effected. The results were thus stated:—In 1829, using coke and cold air, each ton of iron required for its production 8 tons 1 cwt. 1 qr. of coal. In 1830, using coke and heated air, each ton of iron consumed in its production 5 tons 3 cwt. 1 qr. of coal. In 1833, using raw coal and heated air, each ton of iron consumed in its production 2 tons 5 cwts. 1 qr. of coal. The saving in fuel is thus seen to amount to 72 per cent.; and, in Scotland, the production of iron has risen from 37,500 tons in 1830 to nearly 500,000 tons in the last 12 months. There exists a prejudice against the hot-blast iron which is gradually abating; and a similar prejudice long prevented the use of the black-band ore, the value of which was discovered by Mr. Mushett, so far back as 1801. In 1836, every iron-work in Great Britain was visited by M. F. Le Play, chief engineer to the Paris Board of Works; and he estimated the amount produced that year at 1,000,000 of tons. In 1840, Mr. Jessop found that there were 402 furnaces in England and Wales, in which 82, or one in 5, were out of blast; and out of 70 furnaces 6, or 1 in 11, were out of blast. The quantity of iron made, in 1840, was 1,343,300 tons; but, in consequence of the commercial depressions, this fell to 1,046,428 tons in 1842, being a depreciation of 22 per cent. He next directed attention to the effect of railways on the price of iron. In 1836 and 1837, Parliament passed 77 railway bills, of which 44 were for new lines, and the aggregate of extent about 1200 miles, requiring a production of more than 500,000 tons of iron. The price of bar iron which had been £6 10s. per ton in 1834, rose to £7 10s in 1835, and in 1836 to £11; but in 1837, the railway speculation had so far subsided, that only 15 Acts for new lines were passed from 1838 to 1843, the price of iron fell more rapidly than it had risen, and, during this period, iron could be sold with difficulty at less than half the price it commanded in 1836. The average price of iron at Glasgow, in 1844, was £2 5s. 6d. per ton; in March, 1845, it rose to £5; and in May to £5 10s.; this rise in price of 175 per cent. gave such stimulus to production, that the make of pig-iron, in Scotland, for the first six months of this year, was 260,000 tons, or at the rate of 520,000 tons per annum; the production having been doubled since 1840. It is the opinion of the iron-masters that, since 1840, nearly all the increased production of iron in the kingdom has been drawn from Scotland. It appears that the demand, created by the new railways, has stimulated every establishment to its utmost limits of production. But, in order to add materially to the make of iron, a great many circumstances must concur. One of the chief difficulties arises from the workmen: skill is necessary, and the number of those properly trained is so limited, that they make demands for an enormous and disproportionate increase of wages on the first appearance of prosperity. Thus the cost of production seems to have more than kept pace with the rise of price. From this, combined, perhaps, with other causes, the amount of production in England, for 1845, was only 917,500 tons, being 238,000 tons less than the production of 1840. From comparing several returns, it is clear that we have no reason to dread a failure of material—some valuable and extensive fields of black-band ore having been recently discovered in Wales; but it seems not improbable that the Staffordshire iron-works will soon experience a deficient supply of coal. A new source of supply has been found in the refuse and waste of the lead mines of Weardale. The rider of the lead ore is a true carbonate of iron, yielding from 25 to 40 per cent. A small blast furnace has been erected at Stanhope, for smelting this rider, and pig-iron of a strong and excellent quality has been produced. In consequence of this success, the company has commenced the erection of very extensive smelting works, near Walsingham. The difficulty then arises in the supply of labor. It is hopeless to stimulate the exertions of the persons already employed. They are naturally ready enough to exact higher rates of wages when the demand for their labor becomes more urgent; but, succeeding in this, they prefer to obtain the same amount of earnings, with higher rates of wages, to the security of greater gains by the exertions of even the same amount of toil; so that a greater urgency on the demand may be, and frequently is, accompanied by a lessened production. During the period of depression, the low price of iron led to its being extensively applied to various purposes of construction in civil and naval architecture. On the subject of iron ships, Mr. Porter entered into some calculations to show their economy; but the subject will be found more fully discussed in our report of the paper read by Mr. Fairbairn before the meeting of the British Association in Glasgow, in 1840. Up to the beginning of the present century, nearly two-fifths of all the iron used in this kingdom was imported from the north of Europe; but, in 1806, this proportion had fallen to one-eighth, and foreign iron is now only imported for the manufacture of steel. Our exports, on the contrary, have so increased as to become an object of national importance.—

In 1827 we exported 92,313 tons, declared value £1,215,561.
In 1845 “ “ 351,278 “ “ “ “ 3,501,895.

The increase of our exports appears to be contingent on a reduction of price, and must, therefore, be materially affected by variations in the cost of production. Should the new railways stimulate a much larger production of iron, the quantity produced will greatly exceed the demand so soon as those railways are completed; and then prices will fall, perhaps, to a lower point than has ever yet been witnessed. This will, probably, cause iron to be applied to many new purposes, and particularly to the construction of ships, fire-proof houses, and frame-work houses for export to new settlements. All this, however, must be the work of time; and it seems but too probable that, in the meanwhile, our iron-masters will have to undergo a somewhat lengthened season of adversity—for the enduring of which they are, in a measure, prepared, from former experience. Min. Jour.

Extract from Observations on the Tides, deduced from Tidal Observations made in Plymouth Dockyard, from August, 1831, *to September,* 1833.

When the writer began his paper on the tides in 1832, he had a self-registering tide-gauge set up in Plymouth Dockyard, by means of which tide observations might be obtained with tolerable accuracy. He had noticed, when serving in the Mediterranean Sea, that fine settled weather, a high barometer, and a low sea-level, were attendant circumstances; and he ascribed the fluctuations in the level of the Mediterranean to fluctuations in the pressure of the atmosphere. It was considered that changes in the water's surface, arising from fluctuations in atmospheric pressure, might be disentangled from tidal observations, provided the *correct sea level* could be found. This was a subject on which there were doubts. It was considered by Newton, Lalande, and others, that the natural level of the sea was at a point two-thirds below high-water mark, and one-third above low-water mark at spring tides; but the height of spring tides differing among themselves, it is evident that each would give a different *sea level,* and *all* could not be correct. The writer, from some rough observations he had made, considered it more than probable that *every tide* ranged as much above as below the medium level of the sea. The tide-gauge was principally intended to determine these important points. We have already premised that the waters of the ocean would assume a permanent curvature, and their surface would preserve a constant height, unless acted on by external forces; but the surface of the sea being raised by the moon's attraction when in the meridian, and depressed by her when in the horizon, it was considered that these elevations and depressions might be equal, like the elevations and depressions of ordinary waves. On the principle, too, that action and re-action are equal and opposite, the waters of the ocean, when drawn upwards by any force, should descend below their medium level when that force ceased to act. Now a careful discussion of about 2400 tide observations made in Plymouth Dockyard, between 1831 and 1833, has fully established the important fact that the surface of the sea at Plymouth is at half-flood or half-ebb always at the same height, whether at spring-tides or neap-tides, and that every tide ranges as much above as it falls below the half-tide mark, *which is a fixed point,* and may be looked upon as that height which the waters of the ocean would assume if not acted on by solar or lunar influence.

The Lords Commissioners of the Admiralty having communicated to the Royal Society a series of tide observations made in the Royal Dockyards of Portsmouth, Plymouth, and Sheerness, in the years 1831, 1832, and 1833, the president and council caused them to be printed, and, through the kindness of a friend, I was furnished with a copy. It appears, by an examination of these tide observations, that the same law obtains at Portsmouth and Sheerness, and that the medium sea-level is subject to slight changes from atmospherical agencies, which have not been registered in the tidal observations already alluded to.

In connexion with this subject, it may be noticed that about the year 1792, Mr. Graeme Spence, a marine surveyor, was employed by government in surveying the Scilly Islands; he was directed to pay particular attention to the tides among these islands; he accordingly made and recorded a vast number of tidal observations, which, being arranged in a tabular form, were printed by order of the Admiralty for the use of the Royal Navy. Mr. Spence appears to have been a very correct observer of natural phenomena: he set up tide-gauges in the different sounds and channels among the Scilly islands for the purpose of ascertaining the rise and fall of the water for *every hour* during the ebbing and flowing of extraordinary, ordinary, and neap tides throughout the year; from the observations he has left us, it appears that in every sound of Scilly, there is *always* the same depth of water at half-flood, or half-ebb, and that every tide, whether *spring* or *neap*, rises as much above as it falls below the *half-tide level.* It does not appear that Mr. Spence noticed this interesting circumstance, inasmuch as no mention is made of it in the work itself; and it was in October, 1836, that the writer of this article, in looking into Mr. Spence's tables, discovered proofs so corroborative of his own observations. Let us pause to inquire what advantages may be derived from a knowledge of the fact, that there is a point and a time of every tide, when the surface of the sea is at the same height. In the first place, any addition to our stock of knowledge enables us to extend our inquiries, and to explain many apparent anomalies in a satisfactory way.

The natural level of the sea being once known, we are enabled by means of tide observations to ascertain how much the surface may be raised by particular winds. We obtain a zero from which to compute the height of objects on land, and the *depths* of soundings at sea. We obtain a point where the mean pressure of the atmosphere should be measured; where the oscillation of pendulums should be counted, in order to compare the force of gravity in different parts of the world. The medium level of the sea being known, under the mean pressure of the atmosphere, we are enabled to determine in what proportion the surface of the sea should rise when the mercury descends in the barometer, and *vice versa;* and, finally, when the weight of the superincumbent column of air is known, the force and direction of the wind given, we can predict the actual height of future tides. *Ex. gratiâ:* The range of an equinoctial spring tide at Plymouth, *may* be 19 feet 6 inches; this *may* happen when the barometer is as low as 28: and when the barometer is very low a gale of wind *may* blow from the south. Now a gale of wind from the south will raise the water 8 inches in Hamoaze—a *sudden* fall of the barometer $=2$ inches will be accompanied by a rise of the water's surface $=3$ feet 4 inches, so that the natural sea level would be raised 4 feet. If to this be added half the range of the tide as resulting from solar and lunar attraction, we shall have 4 feet $+\frac{19\frac{1}{2}}{2}=13$ feet 9 inches as the height to which the waters would be raised above their medium level under the conditions assumed; namely, 25 feet 11½ inches at the entrance of the North Dock in Plymouth yard. Now this is about the height which the tide reached in the storm of November, 1824. *Engineers should understand these matters before they determine the height of sea walls and other barriers erected to keep out the tides!!*

If it be known that there is a certain depth of water over any shoal at half tide, a pilot may be sure of finding the same depth at every other half tide under similar circumstances. For example, spring tides near the mouth of the Thames rise 18 feet, and ordinary neaps about 9 feet; and since there is about 12 feet water over the flats between the Queen's and Nob channels at low water spring tides, there will be 21 feet at half flood: and since the water is always at the same height at half tide, there will be 21 feet over the flats at half flood or half ebb during neap tides also. If the range of a neap tide be only 9 feet, there would be $21-\frac{9}{2}=16\frac{1}{2}$ feet over the flats at *low water* neap tides. These reasonings apply on *every coast*, and all pilots ought to know them; but few indeed seem to be sensible of the important fact, that in all harbors and channels, and over all shoals, there is an equal depth of water at every half tide, when the atmosphere is in its ordinary state. Lon. Mec. Mag.

On the Origin of the Coal of Silesia, by Prof. GOEPPERT, *of Breslau.*

This paper was an abstract of an essay which received the prize offered by the Society of Sciences of Holland, at Haerlem, in 1844. Prof. Goeppert remarks, that hitherto few well-preserved plants had been obtained from the coal itself, but its composition had been inferred from the plants which lie in the associated shales. In the coal-fields of Upper and Lower Silesia, which yield four millions of tons a-year, he had met with extensive layers, in which the plants were so well preserved, that he could distinguish coal formed from Sigillariæ from that formed by Araucariæ or Lepidodendra. In most instances the bark alone was preserved—the specimens being flattened; but the Araucariæ, being much harder than the rest, often retained their woody tissue and medullary rays. The species, 80 in number, were found to be differently grouped in the various coal strata, and also under different conditions; and this, with the delicate preservation of the ferns, the multitude of upright stems, of which 200 have already been observed, and the uniform thickness of the strata over a space of many miles, are considered by the author a proof of tranquil deposition on the present localities. The Silesian coal strata are from 30 to 60 feet thick; a larger portion of which M. Goeppert supposes to have accumulated after the manner of *peat*,—during the lapse of time. He has ascertained that, by keeping vegetables in boiling water for three months or a year, they are converted into brown coal *(lignite)*, and, by the addition of a small quantity of sulphate of iron, a salt which occurs commonly in coal, acquire, at last, a totally black, coal-like condition.—Sir R. I. MURCHISON expressed his readiness to receive this explanation for the origin of many extensive coal strata. There were other large coal-fields to which the explanation would not apply at all,—the materials having certainly been drifted to a distance by currents of water.—Mr. J. Phillips remarked, that although even fragments of coal-plants were uncommon in the coal of England, yet, with the aid of the microscope, *coniferous tissue* might be detected in much of the fibrous coal, which differed only in being less bituminous than the rest. In the ashes of coal, siliceous casts of vegetable tissue were always to be found; and Mr. Bowerbank had detected traces of structure on the fractured surfaces of ordinary solid coal.—*Trans. Brit. Assoc.* Athenæum.

Process of Coating Iron and Zinc with Copper, without Cyanuret of Potassium.

The great advantages which would arise from perfecting a plan, whereby the easily oxidisable metals, such as iron and zinc, could be coated with copper at a cheap rate, induced Messrs. Elsner & Philip, of Berlin, to undertake a series of experiments, to ascertain if such could not be effected more economically than by employing the cyanuret of potassium, and in this they have been successful. For coating iron the article must be well cleaned in rain, or soft water, and rubbed, before immersing it in the solution, which may be either chloride of potassium, chloride of sodium, with a little caustic ammonia added, or tartrate of potash, with a small portion of carbonate of potash. At the extremity of the wire, in connexion with the copper, or negative pole of the battery, is fixed a thin flattened copper plate, and the article to be coated is attached to the wire from the zinc, or positive pole, and both are then immersed in the exciting solution, the copper plate only partially. The liquid should be kept at a temperature from 15° to 20° centigrade, and the success of the operation depends greatly on the strength and uniformity of the galvanic current. When the chlorides are employed, the coating is of a dark natural copper color; and with tartrate of potash, it assumes a red tinge, similar to the red oxide of copper. When sufficiently covered, the article is rubbed in sawdust, and exposed to a current of warm air to dry,—when it will take a fine polish, and resist all atmospheric influence. In coating zinc with copper, the same general principles will apply as for iron—only observing that, in proportion to the size of the article, the galvanic current must be less powerful for zinc. The surfaces must be perfectly smooth, and for this reason it is well to rub them thoroughly with fine sand, and polish with a brush. Tartrate of potash is the best existing liquid for coating zinc. By very simple means, large articles in iron and zinc may be coated with copper by the above cheap chemical solutions, which could not, at any former period, be effected from the high price of the cyanuret of potassium. Min. Jour.

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CIVIL ENGINEERING.

Report of the Commissioners appointed by the Legislature of the State of New York, by the Act of May 11, 1846, *to locate certain portions of the New York and Erie Railroad, made to the Legislature, January* 14, 1847.

To the Legislature of the State of New York:

The Commissioners appointed by "An Act to amend an Act entitled 'An Act in relation to the construction of the New York and Erie Railroad,' passed May 11th, 1846, and for other purposes," respectfully present the following Report:—

The fifth and sixth sections of the Act direct that the Commissioners shall proceed to adjudge and determine, whether, in their opinion, a practicable interior line or route exists, upon which the Company can construct their railroad, without great prejudice to the public interest of the State, and the interest of the citizens collectively considered, who will be affected by the construction and location of the road.

The seventh section of the Act directs that, in determining the question whether such routes exist, the Commissioners shall take several matters into consideration, among which is a comparison of grades, elevations and depressions, and curvatures, on the line or track of such railroad, in other counties east and west of Sullivan county.

It was urged, on the part of the friends of the interior route, that, under the Act, the Commissioners had only to determine, as an abstract and independent fact, whether a practicable interior line or route existed upon which a road could be constructed without great prejudice to the public interest, and that, in coming to such determination, the Commissioners were not authorized to compare it with any other line or route, or to survey any other route with a view to such comparison.

If such a narrow construction of the Act were to prevail, it is very apparent that the Commissioners would have nothing to do but to establish the interior routes, as it is quite evident such routes are practicable; that it is possible to construct a railroad thereon, and that such railroad, instituting no comparison with *any other line*, can be constructed without great prejudice to the public interest. But these facts were as clear to the Legislature, who enacted the law, as they are to the Commissioners, who act under it. They were perfectly obvious from the surveys, reports, and estimates before the Legislature; and if the Legislature entertained the views pre-supposed by such construction, they would have simply directed the construction of the road, without any useless reference to Commissioners.

It seemed to the Commissioners further quite evident, that whether the interior lines were practicable, and afforded routes for the construction of a railroad, without great prejudice to the public interest, was not a question of mere abstract practicability and freedom from injury, but was necessarily comparative. The Commissioners could not adjudicate as to the matters which they were required by the Act to adjudicate, without comparing the interior routes with some other routes, and from the comparison make the determination. The Act, in the estimation of the Commissioners, clearly contemplated such comparison, as a preliminary to the adjudication; and it was to them as clear, that the comparison should be made between the interior routes, and the routes through Pennsylvania. The application of the Company for leave to construct a portion of their road in Pennsylvania, which was followed by the law under which the Commissioners acted, and from the provisions of said law, clearly indicated the propriety of making such a comparison of routes.

It is believed that the Commissioners were unanimous in the opinion, that as an abstract question, practicable interior lines did exist upon which a railroad could be constructed; and also, in the opinion that it was proper, in making an adjudication, to compare the interior lines or routes with the Pennsylvania routes, both of which had been caused by the Commissioners to be surveyed, and estimates of cost made. It was found, as the result of such surveys and estimates, that the grades of the interior routes were as favorable as they were supposed to be when the Act was passed, and that the expense of construction of the Pennsylvania route would be about a half a million of dollars more than upon the interior routes.

It is believed that the Commissioners were unanimously of the opinion that the Pennsylvania routes, though constructed at a greater cost, and paying $10,000 annually as a tax to the State of Pennsylvania, considered solely in view of the natural advantages of the two routes, would yet, from the much more favorable character of the grades, be the preferable route for the Company to adopt, and for the public to employ.

The evident purpose of appointing the Commissioners was, that they should obtain the facts accurately, compare the merits of the two routes candidly, and determine upon the interior routes, unless the merits of the Pennsylvania routes greatly preponderated. If the surveys of the interior routes should prove to be more favorable than the surveys of the same routes previously before the Legislature, it does not therefore follow, necessarily, that the interior routes should now be adopted. If that had been intended as a necessary consequence of such favorable results of the surveys, the Legislature would have so said. If the grades in the counties east and west of Sullivan, are steeper than the grades on the interior routes through Sullivan, it does not therefore necessarily follow, that such interior route should be adopted. The Legislature have not so directed. The more favorable grades shown by the recent surveys, are facts to be taken into consideration by the Commissioners, and to have their due influence; but they are not to outweigh all the other facts of the case.

The important question is, can the road be constructed on the interior routes "without great prejudice to the public interest," and what, within the meaning of this Act, is to be deemed such great prejudice, as, when compared with the advantages of a more favorable location, to forbid the construction on the interior routes. The interests of the citizens, who are to be affected by the location of the railroad, collectively considered, are to be taken into the account in making up the estimate of prejudice to such interests.

The interests of all the citizens living upon the line of the road, or within the vicinity of the line of the road, or whose property will be transported to market by means of the road, or who will be interested in the traffic of the road, will be affected by its location and construction.

Having submitted the preceding remarks, on the duties devolved by the Act, the Commissioners proceed to give a statement of their investigations and conclusions under it.

At a meeting of the Commissioners held on the 26th of May, two engineers were appointed; one to make the surveys and estimates required on the routes between the summit of the Shawangunk ridge and Deposit; and the other for the routes between Deposit and a point one mile westerly of the village of Binghampton. Henry Tracy, Esq., was appointed to the first-mentioned routes, and James O. Morse, Esq., to the last-mentioned routes. Those engineers were both on the surveys under the previous commission; and they were directed to enlarge their parties for more full examination.

Under the views taken by the Commissioners, the engineers were instructed to survey the routes that pass through portions of the State of Pennsylvania, on the Susquehanna and Delaware rivers. On the 22d of June, the Commissioners held a meeting in New York, with the view of making a tour over the districts interested in the questions submitted to them, of obtaining a general knowledge of the country, of conferring with such of the inhabitants as desired to make suggestions, and also of advising with the engineers as to the progress they had made, and the probable time when they would be able to submit the results of their surveys.

The Commissioners proceeded to Binghampton, and four of their number, Messrs. Childs, Wilson, Pierson, and Dewey, returned by way of Nineveh to Deposit; thence, via the Delaware river to Port Jervis, and arrived at New York on the 3d of July; a meeting was there held by the Commissioners on that day, at which it was decided that a meeting be held at the same place on the 3d of August; whence they would proceed to Monticello, to Harpersville, and Binghampton, to hold sessions at these places respectively, on the 5th, 10th, and 12th of August, in order to hear such parties as might have any matter to submit to their consideration, in relation to their duties under the Act. It was further decided that public notice of the proposed meetings should be made in one of the newspapers in the city of New York, one in each of the counties of Sullivan and Broome, and in the Albany Argus.

On the 3d of August, the Commissioners met in New York, and thence proceeded to the places indicated, and held meetings agreeably to the above-mentioned arrangement.

At each place, the general result of the surveys made by the engineers was made public, and all persons who were disposed had full opportunity to present their views on the subjects submitted to the Commissioners. The several occasions were improved by friends of the different routes, who entered, in their discussions, fully into the reasonings which they respectively regarded as favorable to the routes they advocated.

General Description of the Routes Surveyed under the Direction of the Commissioners.

Commencing at a point about one mile westerly of the village of Binghampton, and extending eastwardly to Deposit, there are two routes; which, for distinction, are called, one, the Nineveh, or interior route, and the other, the Susquehanna, or river route.

The Nineveh route passes up the Chenango valley to Port Crane, near the mouth of Page Brook, where the heavy grade commences, thence follows Page Brook Valley and reaches the summit between the Chenango and Susquehanna rivers, called the new Ohio summit. To reach this summit, a grade of 65 feet to the mile is encountered. The line then descends and reaches the Valley of the Susquehanna at Nineveh. The line then ascends by a maximum grade of 65 feet per mile to the Bettsburgh summit, which is the summit between the Susquehanna at Nineveh and the Delaware at Deposit. The line then descends to Deposit. The total length is 43·58 miles.

The Susquehanna route passes through the village of Binghampton, and continues up the Valley of the Susquehanna to near Lanesboro, in the State of Pennsylvania. To this point the maximum grade is 20 feet to the mile. It then leaves the Valley of the Susquehanna and reaches the Gulf summit, or the summit between the Susquehanna at Lanesboro, and the Delaware at Deposit. The maximum grade, to reach this summit, is 68 feet per mile. The line then descends to Deposit: the total length is 39·29 miles.

The following tabular statement shows the essential character of the two routes:—

	Susquehanna, or River Route.	Nineveh, or Interior Route.
Maximum grade going east,	68 ft. per mile,	65 ft. per mile.
" " " west,	67 " "	74 " "
Number of summits,	1 summit,	2 summits.
Length of line on which maximum grade rules,	15·66 miles,	35·6 miles.
Total ascent going east,	540 feet,	1087 feet.
" " " west,	395 "	936 "
Total rise and fall,	935 "	2023 "
Minimum radius of curves,	1000 "	1056 "
Total curvature, in degrees,	2371 degrees,	3253 degrees.
Length of lines,	39·29 miles,	43·58 miles.
Total estimated cost of grading, with superstructure on extra length,	$746,900	$628,600

The maximum grades for loads moving eastward are three feet per mile greater on the Susquehanna route than on the Nineveh route. The length of line on which maximum grade rules is nearly twenty miles less on the Susquehanna than on the Nineveh route. The total rise eastward is 547 feet greatest on the Nineveh route. The total ascent, for both east and west, is 1088 feet greatest on the Nineveh route. The radius of minimum curvature is the most favorable, by 56 feet in 1000, for the Nineveh route. The total curvature is 882 degrees, or 2·45 circles, most favorable for the Susquehanna route. From Deposit, the line proceeds down the valley of the Delaware river about 40 miles, to the mouth of the Callicoon Creek. To this point it is common to the two routes between the mouth of the Callicoon Creek and the summit of the Shawangunk ridge, in Orange county.

The two routes between the points last mentioned, for the purpose of distinction, we call, one, the Sullivan county, or interior route, and the other, the Delaware river, or southern route.

The Sullivan county, or interior route, follows up the valley of the Callicoon Creek, thence crossing to the Mongaup and Neversink rivers, and over the dividing ridge, between the latter and the head waters of the Sandberg Creek, which it follows several miles, and thence by the Mamakating valley to the village of Wurtsboro. The distance from the mouth of the Callicoon to Wurtsboro is 52·58 miles. There are several different rates of ascending grade going eastward, the maximum of which is 45 feet per mile. From Wurtsboro, the line begins to ascend the north-western slope of the Shawangunk mountain, and reaches the point of junction at the summit gap in a distance of 8·56 miles, with a maximum grade of 45 feet per mile.

The Delaware river route continues down the valley of the Delaware river, from the point of divergence at the mouth of Callicoon

Creek. It occupies the New York side of the Delaware river for 20·23 miles, and then crosses it to the Pennsylvania side, and follows that side about 27 miles, where it re-crosses, and thence continues on the New York side to Port Jervis. The distance from the mouth of the Callicoon Creek to this place is 48·97 miles; the line then leaves the valley of the Delaware, crosses the table land and the valley of the Neversink, and ascends the north-western slope of the Shawangunk mountain, reaching the summit gap in a distance of 9·56 miles. The grade going east from the Callicoon to Port Jervis, is either level or descending; and from Port Jervis to the summit of the Shawangunk, the maximum grade is 50 feet per mile.

The following tabular statement shows the essential character of the two routes:—

	Delaware River Route.	Sullivan County, or Interior Route.
Maximum grade ascending east,	*50 feet per mile,	45 ft. per mile.
" " " west,	15 " "	†57 " "
Number of summits,	1	5
Total ascent, east,	*454 feet,	1187 feet.
" " west,	316 "	1049 "
" ascent and descent,	770 "	2236 "
" length of line on which maximum grade rules,	9·56 miles,	61·14 miles.
Minimum radius of curves,	1200 feet,	955 feet.
Total curvature,	4588 degrees,	7609 degrees.
Length of lines,	58·53 miles,	61·14 miles.
Estimated cost of grading,	$1,496,430	$1,094,950
Length from the mouth of the Callicoon,	48·97 miles, to Port Jervis,	52·58 miles. to Wurtsboro.

The maximum grade of 45 feet per mile, rules for 61·14 miles on the interior route; and at 50 feet per mile for 9.56 miles on the river route. The total rise and fall is 1466 feet more on the interior than on the river route: the minimum radius of curvature 245 feet less favorable; and the total curvature is 3021 degrees, (equal to 8·39 circles,) less favorable on the interior than on the river route.

In considering the question of motive power on the routes in question, it becomes necessary to understand the influence of the adjacent parts of the road.

Commencing at the point near Binghampton, the road, westward of that place for more than 100 miles, has no grade descending eastward of more than 20 feet per mile. Consequently the trains will come to this point from the west, with loads adapted to a ruling grade of 20 feet per mile. With this load they would continue on the Nineveh route about 8 miles, to near Port Crane, and on the Susquehanna route, 23.6 miles, to near Lanesboro, in Pennsylvania.

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* This applies only to the line from Port Jervis, 9·56 miles to the Shawangunk summit, and the Engineer, Mr Tracy, states this may be reduced to 45 ft. per mile.

† The Engineer, Mr Tracy, says this may be reduced to 48 feet per mile.

The extra power will, therefore, be the amount required above that necessary for a grade of 20 feet per mile. The two routes unite again at Deposit, on the Delaware. The line then runs down the valley of the Delaware, as before observed, 40 miles, to the mouth of Callicoon Creek, and is level, or slightly descending, eastward.

Between the Shawangunk summit and the Hudson river, at Piermont, grades of 60 feet occur.

If the Nineveh and Sullivan county lines were adopted, it would be a question of some practical importance to decide whether it would not be best to make up the trains moving east, (the direction of greatest load,) to go through to the Hudson without extra power. This course would render the level grade, of 40 miles on the Delaware, of little importance; but the inconvenience of changing the arrangement of trains for this distance, would probably counterbalance the advantage of doing so. If the system of extra power at the heavy grades be adopted for these routes, then, extra power must be provided to take a train due to a 20 feet grade, at Port Crane, (near the mouth of Page Brook,) and carry it over grades of 65 feet per mile, for a distance of 35·6 miles, to Deposit. At this place, a train due to a road nearly level, will proceed to the Callicoon, where extra power must be provided to carry it (over grades of 45 feet) to the Shawangunk summit—the entire length of this route. The same, or nearly the same, power would be required to proceed on to Goshen, and increased, so as to adapt it to a 60 feet grade, before the train leaves Orange county. Frequent changes of trains, or motive power, will be attended with inconvenience and extra expense, and in practice, the trains and power will be regulated to avoid changes as much as possible, especially if the road has only a single track.

It will be a near approximation, and simplify the comparison, to consider the routes for computation of motive power, to terminate for the Sullivan county, at Wurtsboro; and for the Delaware river, at Port Jervis. Considering the ascent from both these places to the Shawangunk summit as nearly the same, one 45, and the other 50 feet per mile, (and, as suggested by the engineer, the latter could be reduced to 45 feet,) the trains may be made up at these places respectively, to proceed over the ruling grades to the Hudson river, which are higher than either of the above. The train is then made up at Deposit for a level road and for the interior line; extra power is provided to carry it over the heavy grades between the mouth of the Callicoon and Wurtsboro, or for a distance of 49 miles; leaving the extra length of the line to Wurtsboro, over that to Port Jervis, for a separate estimate.

This arrangement, for a basis of comparative computation, will be as favorable for the interior lines as can be adopted; and it is proper to remark that, in any practical arrangement of business, the Commissioners are of the opinion it would be found most simple, efficient, and not less economical, to make up the train at Port Crane, in Broome county, to proceed to Deposit, and there adapt it to a ruling grade of 45 feet per mile, to be thence carried to the Shawangunk summit, and probably to Goshen. This mode of computation, however, would present a less favorable result, as no benefit would appear for the 40 miles of level grade on the Delaware, above the Callicoon Creek.

It is important to this investigation to know the power and the cost of working locomotive engines.

The Commissioners have devoted their attention to this subject, and though it is one on which there is some conflict of opinion, the results arrived at in the following statement are believed to be sustained by the most extensive experience, where detailed accounts have been kept:—

Cost of Motive Power on Railroads, per Train, per Mile.

1st. Engine men, Firemen, and Station men :—

Baltimore and Ohio railroad,		5	cents.	
Utica and Schenectady "		8	"	
Reading "		4·55	"	
Boston and Worcester "		5·50	"	
Fitchburgh "		7·00	"	cts.
		——	30·05 ÷ 5 =	6·01
New York and Erie "		7·485		

2d. Fuel:—

Reading railroad,	wood, $3·50	23·70		
Boston & Worcester railroad,	" $4·90	22·20		
Fitchburgh "	" $4·25	14·17		
*Baltimore & Ohio "	coal, $2·00	8·00		
		——	68·07 ÷ 4 =	17·02
New York and Erie "		18·09		

3d. Repairs of Engines and Tenders :—

Reading railroad,		4·90		
Boston and Worcester railroad,		9·05		
Utica and Schenectady "		7·93		
Fitchburgh "		5·20		
Western, (Mass.,) "		6·50		
*Baltimore and Ohio, "		9·00		
		——	42·58 ÷ 6 =	7·09
New York and Erie "		8·75		

4th. Oil and Cotton waste:—

Reading railroad,		1·74		
Boston and Worcester railroad,		1·24		
Fitchburgh "		1·30		
*Baltimore and Ohio, "		1·46		
		——	5·74 ÷ 4 =	1·43
New York and Erie, "		2·94		
		——		——
Carried forward,				31·55

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* Estimate of coal trade in 1844.

Brought forward, 31·55

5th. Interest on cost of Engines:—

Baltimore and Ohio railroad, 3·01 = 3·01

6th. Conductors and Brakemen:—

Reading railroad,	4·11
Fitchburgh "	6·20
	10·31 ÷ 2 = 5·15

Take 63 per cent. for brakeman, (which is the ratio on Reading road,) as conductors should not be included, and the expense for brakeman is 5·15 × ·63 = 3·14

Do. Baltimore and Ohio railroad, as per estimate for coal trade, = 2·40

5·54 ÷ 2 = 2·77

New York and Erie railroad, = 6·52

7th. Repairs of railroad, chargeable to locomotive and tender:—

1st. Ordinary repairs; of these one-fifth is regarded as chargeable to motive power:

Reading railroad,	13·66
Boston & Worces'r, railroad,	18·00
Boston & Lowell "	13·50
Western, (Mass.,) "	13·75
Baltimore & Ohio, "	18·30
	77·21 ÷ 5 = 15·44

and 15·44 ÷ 5 = 3·09

2d. Deterioration of iron, not yet settled by experience. Half of this wear is believed to be chargeable to locomotives and tenders, on account of their greater weight. Suppose rail cost $7000 per mile, and will bear transport of 20,000,000 tons on a level road, average say 250 tons freight per train, equal to 80,000 trains. The cost per train will be $8·75 ; and half of this is 4·37

7·46

The weight of engines in the cases above detailed is not known, but is supposed to average less than fifteen tons on their driving wheels: to provide cost for an engine of 20 tons on driving wheels, would require an additional expense; but the fuel on the line of road under consideration would be less

Carried forward, 44·79

Motive power brought forward,		44·79
expensive, by about 7 cents, than the average for the same size of engine. In view of both considerations, it is believed, a reduction should be made from the preceding result of, say,		4·79
And the estimate for a 20 ton engine is	=	40·00

Forty cents per mile run, for motive power with an engine of 20 tons on the driving wheels, appears to be about the cost, as indicated by the experience of the roads above quoted from.

It is difficult to obtain the items of expense, as very few railroad reports present the items separately; and where they are given, they frequently include expenses for both freight and passengers. The weight of trains has an influence on the cost per mile, and in providing for power, reference should be had to this circumstance. The range for a cord of wood is from 15 miles to 40 miles run, according to the weight of train and size of engine.

From the data above presented, with due consideration of the circumstances, we have come to the conclusion, that 40 cents per mile run with a 20 ton engine, is about the actual cost of motive power, including interest, and renewal of engines and tenders, and their proportion (according to the influence of their action on the road,) for repairs and maintenance of way.

Calculation of Motive Power required on Railroads.

Some difference of opinion exists as to the proper data for this calculation. It is generally considered, that an engine in good order will work up to the adhesion of its driving wheels. The main question therefore is, as to the ratio of this adhesion. In the most favorable state of the rails, this ratio may be taken at one-sixth the weight: but in many instances, slightly unfavorable circumstances in the rails, and the condition of the engine, will occur in the ordinary business of the road: and for general purposes, a ratio of one-eighth of the insistent weight is regarded as most favorable data for calculating motive power.

The friction of the cars is another element, and will depend on their condition. For general use, 8½ pounds per gross ton of car and load is considered a proper basis.

The ratio of the weight of freight to the gross weight of car and freight must be considered. Two-thirds is a common rule for a trade that admits of regularity, as coal, &c. For a general business, it is believed, the freight will be about six-tenths of the gross load of cars and freight.

An engine of 20 tons gross weight, all resting on the driving wheels, is assumed as the basis of the estimate—tender, 10 tons. The elements will therefore be:—

Engine = 20 tons = 44,800 pounds, all on the drivers

Adhesion = one-eighth the insistent weight.

Friction = 8½ pounds per ton; this is, essentially, equal to the resistance of gravitation, on a rise of 20 feet to the mile. Of course, for every 20 feet rise per mile, there must be added the power required to move the train on a level.

Ratio of freight to gross load, as 6 is to 10. 44,800 ÷ 8 = 5600 lbs. = tractile power of engine; 5600 ÷ 8½ = 658 tons, gross load, exclusive of engine.

The freight the engine will carry on different planes will be as follows:—

On a level,	658–10(the tender) × ·6 =	in gross tons		389
Ascent 20 ft. per mile,	(658-20) ÷ 2·00-10 × ·6 =	"	"	185·4
" 30 " "	(658-30) ÷ 2·50-10 × ·6 =	"	"	144·7
" 45 " "	(658-45) ÷ 3·25-10 × ·6 =	"	"	107·16
" 48 " "	(658-48) ÷ 3·40-10 × ·6 =	"	"	101·64
" 50 " "	(658-50) ÷ 3·50-10 × 6 =	"	"	98·22
" 60 " "	(658-60) ÷ 4·00-10 × ·6 =	"	"	83·7
" 65 " "	(658-65) ÷ 4·25-10 × ·6 =	"	"	77·7
" 68 " "	(658-68) ÷ 4·40-10 × ·6 =	"	"	74·42
" 74 " "	(658-74) ÷ 4·70-10 × ·6 =	"	"	68·55

The following table shows the ratio of freight carried by the same engine on different gradients; and also the multiplier or number of engines, required on different inclinations, to carry the same load—the unit being a level.

Grade of Road,	Ratio.	Multiplier.
Level,	1·000	
Ascending 20 feet per mile,	·476	2·098
" 30 " "	·372	2·689
" 45 " "	·276	3·630
" 50 " "	·252	3·960
" 60 " "	·215	4·647
" 65 " "	·1997	5·006
" 68 " "	·1913	5·227

It is necessary to consider the ratio of freight moving in different or opposite directions. No certainty can be arrived at as to this ratio. It will no doubt vary at different times. Probably an average of three tons will move east, to one ton west, and there can be no doubt, that the freight moving east will control the question of power, except on that portion which is in the valley of the Delaware river, where the return load of one-third the freight with the whole number of cars, will require greater power than the full load moving east.

The grade going eastward on the Delaware river has a maximum descent of 15 feet per mile, and assuming the ratio of freight to be 3 to 1, the result, as to the greatest load that can be carried on it, will be as follows:

The engine assumed, has been shown to be capable of carrying, on a level, a gross load of 648 tons, exclusive of engine and tender; or 389 tons of freight. The gross load the engine will carry up an ascent of 15 feet per mile, exclusive of engine and tender, is 357 tons. If the freight be 358 tons, the gross load of cars and freight will be 596 tons. The cars for this load will be 238 tons. To return with one-third the freight, and all the cars, the load will be $358 \div 3 + 238 = 357$ tons. It has been shewn that 357 tons is the capacity of the engine on this ascent; consequently, the load moving east can only be 358 tons of freight. The load moving east is, therefore, restricted by the load moving west.

The gross load due on an ascending grade of 20 feet, is 309 tons, the freight 185·4 tons. The weight of cars required for this load is 124 tons, one-third the freight is 62 tons; together 186 tons. To return up a 74 feet grade, will require 63 per cent. additional power. It therefore appears, that the train engine, with a load due to a grade of 20 feet per mile, (this would be the train from Hornellsville to Port Crane,) moving east, would require extra power to return on the interior route from Deposit to Port Crane, equal to 65 per cent.

The investigation, as applied to the line between Deposit and Wurtsboro, shows the following result: Down the Delaware, it has been shown, the load is 358 tons of freight. That portion of the interior line embraced in this section has a return grade of, say, 48 feet per mile. [In the table it is given at 57 feet, but, as there noted, the engineer states it may be reduced to 48 feet.] To return with cars and one-third freight, over the interior portion of the section, gives a gross load of cars and freight of $358 \div 3 + 238 = 357$ tons. The engine will carry 169·4 tons up this ascent; consequently, 2·10 engines, or 1·10 extra engines, will be required to carry the return load.

From Wurtsboro to the Shawangunk summit, the line has a ruling grade of 45 feet to the mile. From Port Jervis to the same point, the ruling grade is given in the table at 50 feet, but the engineer states this may be reduced to 45 feet, in which case they may be regarded as the same. It will not be very material whether the latter is 45 or 50 feet, as the trains would, in practice, most probably be made up at either point so as to encounter the heavier grades, that occur towards the eastern termination of the road. This being about 70 miles, it is not probable there would be a second change of train for this distance. There will, therefore, be no material difference whether the computation for the purpose of comparison be made to the Shawangunk summit, or stop on one line at Wurtsboro, and on the other at Port Jervis.

For the computation of extra power, it is proposed to take the Hornellsville train, which will be loaded for a 20 feet grade, and by extra power carry it over the heavy grades to Deposit. At this place make up a train that will be suitable for the Delaware river section, and provide extra power sufficient to carry it over the heavy grades between the mouth of Callicoon Creek and Wurtsboro; leaving the trains to be there made up either at Wurtsboro or Port Jervis, for the heavy grades between those places and Piermont. This method will require but two changes of trains between Binghampton and Pierpont, and in view of the whole subject is regarded as presenting a fair basis for comparing the two lines. It gives the interior route the full benefit of the favorable grade on the Delaware, between Deposit and the mouth of the Callicoon, which may not, and probably will not, be wholly available in practice; and the river route has some additional elevation between Port Jervis and the Shawangunk summit, which may be regarded as a partial offset.

It has been shown that extra power will be required mainly as aid to the train moving eastward, and that a portion of this power will be required for the return train. A part of the extra power required to move the train eastward might be dispensed with when it reached the last summit of the ruling grade. There will, however, be practical difficulties in this. It will cause too much change in arranging the power, and tend to confusion in conducting the business of the road; and it will deprive the heavy trains of the power that is sometimes quite necessary, and generally a convenience, in regulating their descent on the heavy grades. There are times when the state of the rails is such that it is impossible to control the trains on a heavy descending grade by means of the friction brake alone—where the power of the engine is indispensable; and even that is not always sufficient. In view of all the circumstances, there can be no doubt the most judicious business arrangement would be to run the extra power over the whole section affected by the ruling grade, both ascending and descending, in the direction of the greatest trade. As the extra power must run in both directions over the section requiring its aid, it will always be competent to carry the return load; and as the load eastward will determine the amount of extra power necessary to be provided, the computation will be simplified by considering it charged wholly to the freight moving in this direction. The engines must return, and though partially loaded with the train moving westward, the expense or comparison will not be affected, whether it be charged in this manner, or divided between the freight in both directions. The total cost of extra power will be therefore charged on freight moving eastward.

It has been shown that the cost of running an engine weighing 20 tons, and capable of carrying a train of 389 tons freight on a level, will be 40 cents per mile run. It is, however, well known that extra power, kept in readiness for running at intervals, and for short distances, cannot be maintained at the same expense per mile run, as a regular train engine. The extra power must be adapted to the load, and this may require more than one, and less than two engines; consequently, two must be employed. Two or three engines coupled to the same train, will not perform as much, in proportion to their power, as if worked separately; and if the train is separated, and made up into several smaller ones, delay and expense are incurred. The power must be provided for a full load; but a general trade will be more or less irregular, and as the trains working on a long road must move at regular times, they will not always be full loaded, and the average will fall considerably below the capacity of the engines. This remark applies to the question of power generally, and is not peculiar to the provision for extra power. We are of the opinion that this extra power, for the reasons above given, will cost not less than 50 per cent. per ton of freight per mile, more than that of engines in regular work, and carrying loads equal to their full capacity. The ratio of increase in cost, from the considerations above stated, cannot be arrived at with certainty, and though we think it will exceed the regular computation more than 50 per cent., this ratio will be assumed in the following estimates.

Collecting the data that have been presented, we now proceed to give the expense of extra power, and make a comparison of the several routes, on the basis that has been submitted.

Nineveh, or Interior Route.

The extra power to carry a train due to an ascending grade of 20 feet per mile up a grade of 65 feet per mile, (the ruling grade on this route,) is 1·386, or nearly 1·4 engines. We have, then,

$40 \times 2 \times 1{\cdot}386 \times 1{\cdot}5 = 166{\cdot}32$ cents per mile run, with a load of 185 tons; $166{\cdot}32 \div 185 = 0{\cdot}9$ cents per ton per mile.

This route is 4·29 miles longer than the Susquehanna, or southern, route. For this distance, the whole cost of transportation, exclusive of depot expenses, is chargeable to the interior route. This, on a ruling grade of 20 feet per mile, ascending in the direction of the greatest trade, is estimated at one cent per ton per mile on the freight carried in both directions. The freight going westward is estimated at ⅓ of that going eastward, and hence a charge of 1⅓ cents per ton per mile, on that moving eastward, will cover the cost on freight in both directions.

The extra expense all computed on freight going eastward, will be per ton as follows:—

On 35·6 miles, (length that heavy grade rules,) at the rate of 0·9 cents,	32·04	cents.
On 4·29 miles, extra length of line, and to cover freight in both directions, though only chargeable on that moving east, at the rate of 1⅓ cents,	5·72	"
Per ton of freight,	37·76	"

Susquehanna, or River Route.

The extra power to carry a train due to an ascending grade of 20 feet per mile, up a grade of 68 feet per mile, (the ruling grade on this route,) is 1·491, nearly 1½ engines: computed on the basis above adopted, is,

$40 \times 2 \times 1{\cdot}491 \times 1{\cdot}5 = 178{\cdot}92$ cents per mile run, with a load of 185 tons. $178{\cdot}92 \div 185 = 0{\cdot}97$ cents per ton per mile.

The length on which ruling grade prevails is 15·66 miles, at 0·97 cents per mile,=15·19 cents.

Comparison of the two routes:—

Nineveh route, - -	37·76	cents
Susquehanna route, -	15·19	"
Difference in favor of Susquehanna route,	22·57	"

(To be continued.)

On the Law which governs the Resistance to the Motion of Railway Trains at High Velocities. By Mr. Scott Russell.

Having on former occasions communicated the results of experimental researches concerning the resistance experienced by floating bodies moving along the surface of water at high velocities, I have thought it not an inappropriate sequel to communicate the general result of a long series of experiments made partly by committees of this Association, and partly by myself. The subject of the resistance which requires to be overcome in order to give motion to trains at high velocities, has been matter of great uncertainty, some dispute, and the cause of several grave errors in practical engineering. Some six years ago, a committee of the Association was appointed to make experiments on this subject, and these experiments were at the time a valuable addition to our knowledge. They showed that the resistance at such velocities as 36 miles an hour was much greater than had been supposed—at least double. The committee, however, in concluding their labors, stated that they were not able to deduce from them any law, or semblance of a law; that the resistance increased with the velocity,—but it did not appear to do so according to any simple function of the velocity, neither as the velocity directly, nor as the square of the velocity. Since that time, the question has been a *quæstio vexata* among practical men and mathematicians. A paper read at the Royal Society last winter comes to the same conclusion as the old committee of the British Association, viz.—that no law is manifested in the experiments,—of which, at high velocities, the results are quite anomalous. The consequences of errors on such a point have become now so serious, especially where velocities of 50 or 60 miles an hour are attempted, that it has been reckoned desirable that the question should be, if possible, thoroughly resolved. For this purpose, I have undertaken a series of practical experiments, on a large scale, with railway trains of a great variety of size and weight, and at velocities as high as 61 miles an hour. They were made on the South-Western, London and Brighton, South-Eastern, Sheffield and Manchester, and Croydon atmospheric railways. I have combined with these, the experiments formerly made by the British Association, and some by Mr. Harding, on the broad gauge; and it is the result of this great variety of facts which I wish to lay before the Section.

The following experiments show the great amount of resistance at high velocities; but they also show the apparent anomaly of the results. We have many higher velocities than others with much lower resistances. These are the difficulties in the way of any simple and apparent solution. The method of investigation I have adopted is this—I have taken all the results of experiments, and removed from them, in the first instance, all the questionable experiments. I found it necessary to discard all the experiments made with accelerating velocities, and to retain only such as were made on uniform velocities, in the same circumstances, over a large space; most of my own experiments having a steady uniform velocity over from one mile to six.

I have also selected those which were most free from the action of wind—an element of much importance. By thus weeding out the experiments, and taking only the most unquestionable, I simplified the subject very materially. Those which remain are given in the table.

No. of Experiment.	Uniform velocity maint'nd in miles per hour.	Resistance in lbs. per ton by experiment.	Resistance in lbs. per ton by formula.
1	10	8·40	9·30
2	14	12·60	13·90
3	14	12·60	13·90
4	29	16·50	15·70
5	31	23·30	25·40
6	31	18·20	16·30
7	32	22·50	27·20
8	33	22·50	22·70
9	33	15·68	16·90
10	33	15·96	17·00
11	34	16·60	17·30
12	34	16·95	17·30
13	34	17·70	17·30
14	34	23·30	27·20
15	34	25·00	23·10
16	35	22·50	26·10
17	36	22·50	22·40
18	36	22·40	21·50
19	37	17·50	18·20
20	37	25·00	28·40
21	39	30·00	31·00
22	41	22·99	19·60
23	41	26·78	19·60
24	45	21·70	21·00
25	46	23·10	21·30
26	46	30·31	31·00
27	47	33·70	33·10
28	50	32·90	36·30
29	51	26·40	23·00
30	53	41·70	42·10
31	61	52·60	54·80

In this table, the weight of each train, in tons, is shown, and the number of pounds of force required to keep each ton weight of that train in motion at a given number of miles per hour, is shown by actual experiment. The analysis of those experiments I made as follows:—I take the friction of the axles and wheels as an ascertained quantity, equal, in the best conditioned carriages, to 6 lbs. per ton of train. This, I conceive, we may consider to have been proved by all experiments of friction, including those of Mr. Morin, the latest and best, to be a source of resistance constant at all velocities. This I call friction proper, and I consider it as the first element of resistance. Friction proper, the first element of resistance,—or

[1] $$R_1 = C\,m,$$

Where $C = 6$ lbs., and $m =$ the mass of the train in tons weight.

The second element of resistance is the resistance of the air to the front of the train. This has been variously estimated, and somewhat erroneously. Some persons have taken for it Smeaton's tables of the force of the wind. But such a table gives a quantity quite in excess; for these tables were made from the force of the wind upon a *thin* plate, a case where the minus pressure behind is added to the plus pressure before the plate; whereas, in the case of the railway train, there is a solid body, whose third dimension extends the whole length of the train. I have therefore taken, not the table of the force of the wind, but a table of the resistance of air calculated from the height due to the velocity, which I have found to represent most accurately the resistance of fluids to bodies passing through them; and I have taken this as the second essential element in the resistance to railway trains. Resistance of the air, the second element:—

[2] $$R_2 = A\,p\,v^2,$$

Where $A =$ the area, in square feet, of the front of the train, and $p =$ weight of a column of air, whose base is a square foot, and whose length is the height due to the velocity of one mile an hour; v being the velocity of the train.

After having deducted from the results of the experiments the sum of these two resistances, I have found a large amount still unaccounted for; and I find this quantity to be not only large, but dependent also on the velocity. The question which I now submit to the Section, is the determination of the nature and cause of this third element of resistance. The third element of resistance appears, by the experiments, to increase very nearly as the velocity; simply, that is, it amounts, at 10 miles an hour, to about 3 lbs., at 30 miles an hour, to 10 lbs., and at 60 miles an hour, to 20 lbs. per ton. It is, therefore, proportioned to the mass, or weight, of the train, and to the velocity jointly. Other resistances due to velocity, or third element:—

[3] $$R_3 = B\,m\,v,$$

Where $\frac{1}{3}$ lb., m, the weight of the train in tons, and v, its velocity in miles an hour.

Whence the total resistance (R,) to any train of any weight, moving with any velocity, is to be obtained from the formula

[4] $$R = R_1 + R_2 + R_3 = A\,p\,v^2 + B\,m\,v + C\,m.$$

The results of this formula are shown in the last column of the table; and from the close manner in which they follow the experiments through their various and apparently anomalous results, they may be regarded as an approximation to the truth sufficiently close for all practical purposes. The next question discussed, was the nature of this third element—resistance. The author attributed it mainly to the concussions, oscillations, frictions, and flexures, to which all the portions, both of the train and permanent way, are subject, at high velocity.

Dr. Robinson observed that this was a subject on which we had been for some time very much in want of accurate information, and he was very glad it had been taken up by Mr. Scott Russell; who would, he hoped, throw as much light on the resistance to railway trains as he had already done on the resistance to ships moving through the water. He quite agreed with him as to the nature of the first two elements of resistance forming two terms of the formula. He also agreed, to a certain extent, to the existence of the third element, which Mr. Russell represented by the term $\mathrm{B}\, m\, v$. But he hoped the experiments would be extended, and that this term, instead of appearing as it now did, would be analyzed into some further elements. He had paid some attention recently to this subject, and had stated his views to the Committee of the Houses of Parliament, before which he had been examined, on the atmospheric railway; and he conceived that there existed a term of resistance due to the imbedding of the wheel in the rail, which would be of some such form as $\mathrm{B}\ m\ v^{\frac{1}{2}}$. There would also, he thought, be another term due to the resistance of the spokes of the wheel, and another due to the adhesion of air to the sides, consisting of two terms,—one increasing as v, and another as v^2. These, with axle furniture, rolling friction, and the other elements he mentioned, would be found to be concealed under the present aggregate $\mathrm{B}\, v\, m$; and he sincerely hoped these researches would not cease until the analyses were thus rendered complete.—Mr. Scott Russell concurred in the views of Dr. Robinson, and would not fail to prosecute the subject. He thought it of especial importance from this fact, that the element, or group of elements, represented by $\mathrm{B}\ v\ m$, was large, and, practically, very important; but it was also one which the skill of the engineer might very much diminish, by attending to the construction of the permanent way, and the improvement of the carriages.— *Transac. Brit. Assoc.* Lond. Athenæum.

AMERICAN PATENTS.

List of American Patents which issued in the month of March, 1846,—with Exemplifications, by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For *Improvements in Chimney Caps, for Ventilating Apartments;* Moses Chase, Boston, Massachusetts, March 7.

The following extract and claim, taken from the specification, will give the reader a clear idea of this improvement, viz:—"As ventilators have heretofore been constructed, they have only served the purpose of discharging the foul air from the apartment, or increasing the draught in a flue by the action of the external current of air near their discharging mouth. By my improvements, I effect, in addition to the result above suggested, the introduction of a current of fresh air from the windward end of the horizontal tube of the ventilator, which greatly facilitates ventilation, and assists, in some degree, the discharging operation from the leeward end of said horizontal tube.

"When my apparatus is used to increase or improve the draught in chimney flues, I carry the descending, or fresh air tube, down a proper distance in said flues, and I apply to the lower end of the descending tube a reflecting cap having a cylindrical part larger in diameter than the lower end of said tube, and a conical bottom, which reflects the downward current of fresh air in the tube in a manner which will be readily comprehended."

Claim.—"What I claim, therefore, as my invention, and desire to have secured to me by letters patent, is a ventilator, or chimney cap, (with a horizontal turning top,) *having a descending flue, or tube, for the introduction of fresh air, opening from the windward end of said horizontal turning top, and passing down through the discharging flue, or tube, and below the bottom of the same, as herein set forth;* the whole arrangement being substantially as hereinbefore specified.

"I also claim the combination of the reflecting cap with the bottom of the descending, or fresh air tube, the arrangement and purpose of the same being substantially as above set forth."

2. For an *Improvement in Setting Logs on the Carriages of Saw Mills;* George Sweney, Bucyrus, Crawford county, Ohio, March 7.

The claim in this patent is wholly dependent on the drawings, the publication of which would carry us beyond our limits, considering the nature of the invention, which is, in the patent, limited to the combination of certain levers, connecting rods, and their appendages for raising the head end of the log, to move it sidewise to the required distance.

3. For *Improvements in Cooking Stoves;* R. D. Granger, Albany, New York, March 7.

These improvements are applied to the double oven stoves, that is, to that class of stoves which have two ovens, one back of the fire chamber, and the other below, with a horizontal flue between the two, the lower oven extending under the fire-place. The rising flue, at the back of the bottom oven, instead of being vertical, rises in a semicircle, to throw the heat as far under the upper oven as possible before it turns back to pass through the flue at the back of the upper oven. This is covered by the first section of the claim. And the second improvement relates to the introduction of a draught to the under part of the grate through a tube placed in the direction of the horizontal flue between the two ovens, and passing through the front diving flue; and also to the introduction of a draught of air through a register at the top of the stove, and above the fire chamber.

Claim.—"I claim the *curved* flues in the rear of the lower oven, as herein shown and described, serving to throw the heat somewhat backwards upon the bottom plate of the upper oven.

"I also claim combining with the two ovens and their respective flues, the upper and lower draught, and arranged and operating substantially as set forth."

4. For *Improvements in Saw Mills;* Russel S. Morrison and Benj. B. Cushing, Frankford, Waldo county, Maine, March 7.

Instead of having but one carriage, as usual, with the head block at one end, and the tail block at the other, there are, in the invention before us, two carriages, one having the head block, and the other the tail block, and each carriage moves independently of the other. Two rollers are placed, one in front and the other back of the gang of saws, to sustain the log, and back of the saws there are two sets of thin wheels, one above and the other below the log, and running in the saw carfs to guide the log, and sustain the several boards that are being cut in their proper relative positions. The log, instead of being supported on the head and tail blocks at the same time, is first clamped on the tail block, which moves with one of the carriages, to present the head end of the log to the gang of saws, and feed it forward until cut through sufficiently to have the head end received and clamped on to the head block of the other carriage, which continues to move the log until it is cut through; the carriage of the head block, in the meantime, being carried back to receive another log.

Claim.—"Having thus described our invention, what we claim as new, is the combination of the two carriages and sustaining rollers, or other mechanical equivalents, with one or more saws; the whole being arranged and operated substantially as specified.

"We also claim the employment and use, in combination with the saws and carriages, of one or more series of circular or other proper-shaped revolving guide plates, the same being for the purpose of preserving the boards, or sawed sections of the log, in their vertical or true positions, as above explained."

5. For an *Improvement in Pistons for Pumps, Steam Engines, &c., called the "Rolling Segmental Frictionless Piston;"* David Hinman, Brunswick, Medina county, Ohio, March 7.

This invention consists in substituting for the metallic, or other packing, and the hinged flap, the rolling of metallic or other hard substances on each other, by making the piston of three, four, or more triangular parts, turning on rounded edges along the outer faces of the triangles, the outer faces being made in the form of segments of cones, and rolling on each other when moved together in the same direction—all the segments being jointed to one piston, or connecting rod. The effect of their vibration will be similar to the working of the flap of a bellows.

Claim.—"What I claim as my invention and desire to secure by letters patent, is composing a piston of three or more segments, rolling on each other as they vibrate together, each on a separate axis, along or near to their outer edge, substantially as herein described."

6. For a method of *Preventing the Hatches of Vessels from Leaking;* Richard C. Holmes, Cape May, New Jersey, March 7.

The nature of this invention consists in making a groove, or gutter, in the upper face of the frame of the hatch-way, over which the hatch, or cover, rests, to catch the water that may leak through the joints, and discharge it on to the deck through apertures or tubes leading from the bottom of the groove, or gutter, to the outside of the frame; the said apertures being governed by valves opening outwards, to permit the escape of the water, and prevent a sea, in passing over the deck, from entering the valves.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the method, herein described, of preventing the hatchways of vessels from leaking, by making a groove, or gutter, in the framing on which the hatch, or cover, rests, with apertures or tubes leading therefrom to the outside of the framing, in combination with the valves governing these apertures, and opening outward to permit the escape or discharge of water from the groove, or gutter, and prevent water from washing in, as herein described."

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7. For an *Improvement in Separating the Grain from the Straw in Threshing Machines;* Pliny Weller, Fowlersville, New York, March 7.

The straw and grain are thrown from the threshing machine into a rotating cylindrical screw, from which the straw is discharged on to an endless apron, to be carried off, while the grain which passes through the meshes of the screen, is delivered on to another apron, below the straw apron, to be delivered to another rotating screw, to be separated from the chaff by a fan.

Claim.—"I do not claim to be the inventor of the threshing apparatus, or of the revolving screws or of either of the parts thereof, taken separately; but what I do claim as new, and desire to secure by letters patent, is the manner in which I have combined and arranged these parts, so as to produce a new and useful effect; that is to say, I claim the combining of the two rolling screens with the two endless aprons, so as to effect the separation and cleaning of the grain, in the manner set forth."

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8. For an *Improvement in Filters, for Filtering Water and other Liquids;* Wm. H. Jennison, New York, March 7.

The patentee says,—"Of the various substances which have been employed as filtering media, sponge has heretofore been deemed the least useful, from the circumstance that in its natural, or slightly compressed state, its pores readily admit and become clogged with the impurities, and in a very short time impede the passage of the liquid, and after these impurities have filled up the pores it is very difficult to remove them; but by a series of experiments, I have ascertained that by submitting well cleansed sponge to a pressure of about five thousand pounds, and retaining it in this compressed state, it will admit of the passage of water or other liquid through it, and retain the impurities outside. Having ascertained this fact, I have applied sponge thus compressed to the filtering of water and other liquids with great advantage in the following manner. The sponge is torn into small fragments, and properly cleansed, to remove all impurities, and then, in a moistened state, I compress it under a pressure of about five thousand pounds, and confine it between two perforated metallic plates, forming a diaphragm, which is placed in a case with a chamber on either side, so that the water or other liquid can be carried through it, first in one direction, and then in the other, so that the impurities which are deposited alternately on its opposite surfaces, shall be readily carried off by the water, or other liquid."

Claim.—"What I claim as my invention and desire to secure by letters patent, is forming a filtering medium, for filtering water and other liquids, of sponge, compressed under a sufficient pressure to prevent sediment from entering the pores thereof, and permit pure water, under pressure, to pass through, as described; the sponge thus compressed, being confined and retained between two perforated plates, as described."

9. For *Improvements in the Machine for Reaping Grain;* Wm. F. Ketchum, Buffalo, New York, March 7.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the manner of constructing the rake teeth, the same consisting of two plates of unequal length, and each set being made separate, and not a whole plate, as heretofore. I claim, further, the arrangement of having the operating parts, as the driving wheels, under the platform on which the cut grain falls, as illustrated in the specification and drawings.

"I claim in particular, using one or more revolving sharp-edged shafts, for the purpose to carry the cut grain from the knife-blade to the platform, in the manner set forth."

10. For an *Improvement in the Manufacture of Soap;* Dominique Frick Albert, a citizen of France, now residing in Manchester, England, March 7.

Claim.—"What I claim as my invention, is the saponization of animals' entrails, or butchers' offals, by the means of a strong caustic alkali, in the manner and for the purpose set forth and described."

11. For *Improvements in the Mortise Door Latch;* Rodolphus Kinsley, Springfield, Massachusetts, March 7.

The patentee says,—"In making mortise latches, much difficulty has been experienced in giving a form to the case to suit thin doors, and at the same time adapted to the reception and working of the mechanism, and the fitting of a mortise made entirely by boring, to avoid the labor of mortising with a chisel. This end has been sought by substituting the cylindrical for the square form; but to adapt this to the reception of a properly formed tumbler, requires too great a diameter to suit a medium thickness, or thin door. But, by one of my improvements, I attain this desideratum by forming the cross section of the case of three circles; one in the middle, to form the thickness of the case, and two small ones, one on each side of, and bisecting, the middle one, to form the width of the case, so that a hole formed by boring one large hole and two small ones, will receive the latch case, the diameter of the large one being sufficient to give to the arch of the tumbler the required length, and the two small ones giving sufficient width for the working of the levers of the tumbler and the wings of the latch bolt, on which the tumbler acts, to operate it.

"My second improvement consists in so locating the helical spring which protrudes the bolt, within a recess therein as to have one portion of it rest on a flanch connecting the two sides of the bolt, and the other end on a shoulder of the stud against which the permanent end of the spring rests; by means of which arrangement, much of the friction, and consequent wear, of the spring against the case, is avoided."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the form of the case of mortise latches by the union of three circles, one large one in the middle, and a small one on each side, the three intersecting each other, substantially as herein described, to leave greater strength in the wood of the door on each side, as specified, and to admit of fitting into the door by boring simply.

"I also claim locating the helical spring in a recess in the body of the latch bolt, in combination with the mode of preventing friction and wear, by sustaining one end on a flanch, or plate of the bolt, and a shoulder on the standard, as herein fully explained."

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12. For an *Improvement in Door Locks;* John H. Davis, Lumberville, Bucks county, Pennsylvania, March 7.

The patentee says,—"The nature of my invention consists in fitting up the lock with revolving escutcheons, connected with a wheel inside the lock, in which there is a hole only large enough to admit the key, so that when the key is turned in the lock, the key-hole will be closed on both sides; and by means of a notch in said wheel, into which a pall falls, the escutcheons are fastened in a position covering the key-hole when the door is locked; the catch of the latch is so constructed that it can be reversed, making the lock a right or left-hand one, at pleasure."

Claim.—"Having thus fully described my improvements, I wish it to be understood that I do not claim as my invention a revolving wheel, or cover, for a key-hole in a lock, as that has before been applied; but what I do claim as my improvement and desire to secure by letters patent, is the combination of the revolving escutcheons and wheel with the bolt and pall, in the manner described, so that when the bolt is locked, and the key-hole closed, the lock is perfectly secure from attempts outside, and when drawn back, it can be locked equally well from either side."

13. For an *Improvement in the Manufacture of Soap;* Jacob Keen Vaughan and Evan Henry Everman, Philadelphia, Pennsylvania, March 7.

The following is extracted from the specification, viz:—"The specified quantity of ingredients for compounding 3000 lbs. of improved soap are as follows:—best yellow soaps, 900 lbs.; water, 2100 lbs.; boras sodæ, (or common borax,) 75 lbs.; sodæ murias, (or common salt,) 37½ lbs.; glue, best manufactured, 15 lbs.; palm oil, 10 lbs. Dissolve the soap in the water by slow boiling, then add the glue (in a dissolved state) and the palm oil, and continue the boiling and stirring until brought to a boil, then add the borax and salt; leave the mixture to boil a few minutes, when it is finished, and may be poured into moulds to cool."

Claim.—"What we claim as our invention and desire to secure by letters patent, is the application and addition, to a given quantity of soap, of water, borax, salt, glue, and palm oil, which will increase the quantity, and improve the quality, of the soap used, as herein described."

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14. For an *Improvement in the Machine for Planting Corn and other Seeds;* James Putnam, Hamilton, New York, March 7.

The tooth which forms the furrow, is made with wings of teeth on each side. The following extract will explain the nature of the second improvement claimed:

Claim.—"What I claim as new, and desire to secure by letters patent, is the combining of the lateral rakes with the furrower, for the purpose of preventing the coverers from drawing in of stones, or other hard substances, over the seeds. I claim the device described, for the checking of the shafts, as set forth, in order to facilitate the turning of the machine at the expense of each furrow."

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15. For *Improvements in the Permutation Lock;* Francis B. Pye, New York, March 7.

The patentee says,—"In my improved lock, the key is surrounded by a hoop, which is nearly equal in depth to that of the bit of the key; this hoop, however, does not constitute a perfect cylinder, an opening being left in it which is to be occupied by the end of the bit when the key is inserted. Above this hoop, there is a revolving circular plate that is received within a groove in the face plate, or cover, of the lock; through this plate the key hole is made, and it is turned round by the bit of the key, along with the hoop above named. The pin that receives the barrel of the key is not in the centre of the hoop, and as it is turned round, the acting part of the bit projects beyond the hoop, and operates upon a set of levers which I denominate the key levers, and raises these levers to different heights, governed, of course, by the arrangement of the parts of which the bit of the key is composed, and upon which the permutation is dependent. As these levers are raised, they act upon another set of levers, which I denominate the intermediate levers, and these operate upon a third series, which, as they are immediately connected with the bolt, I denominate the bolt levers. It will be seen by those who are acquainted with the manner of constructing the several permutation locks that have within a few years been the subject of letters patent, that I dispense entirely with the slides and tumblers used in most of those locks, and substitute therefor, levers working upon suitable fulcra, or pivots, and it is from this circumstance that I have been induced to denominate my lock the *permutation lever lock.*"

Claim.—"I do not claim as of my invention either of the parts of this lock taken individually, but only as combined and co-operating with other parts, in the manner set forth; but what I do claim as new and of my invention, is, first, the manner of arranging and combining the hoop with the revolving plate, the partition-piece, and with the key levers; the pin that receives the barrel being placed eccentrically with the hoop, and the hoop and the plate revolving with each other, as described.

"I also claim the manner set forth of arranging and combining with each other the key levers, the intermediate levers, and the bolt levers; the whole of them having fulcrum pins on which they rise and fall, and not operating as slides in a direct line; by which arrangement, they are rendered more certain in their action.

"I claim the manner in which I have arranged and combined the auxiliary levers with the clawed talons, the bolt levers, and with the respective studs, so as to operate for the purpose and in the particular manner herein set forth. I do not claim the use of talons with claws to engage in notches, or teeth, on slides; but I limit my claim to the special arrangement herein made known.

"I claim the manner of employing a latch in combination with the bolt, levers, lifting-piece, and the spring for the purpose of preventing the pushing back of the bolt when it is but partially shot out, the respective parts concerned in this operation being arranged and acting substantially as described."

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16. *For Improvements in Night, or Safety Latches;* Amos Call, Springfield, Massachusetts, March 7.

The patentee says,—"The invention consists in having one of the knobs of the latch so fixed as that it can be connected with the tumbler, or disconnected, at pleasure, and when on the outside of a door it can be controlled by a person inside; whilst the inside knob is so affixed to the spindle as always to act on the tumbler in the usual way. This improvement can be applied to all varieties of latches moved by a revolving spindle and tumbler."

Claim.—"What I claim as my invention and desire to secure by letters patent, is connecting the knob of a latch with the spindle in such a way as that it can be made to turn either with or without the spindle, by means of a bolt acted on the opposite side of the door, to control the action of said knob, substantially in the manner and for the purpose herein set forth."

17. For *Improvements in Machinery for Reaping, Threshing, and Cleaning Grain;* Jeremiah Darling, Adrian, Michigan, March 7.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the carrying or gathering platforms, formed of slats with pointed teeth thereon, and moved substantially as described, with the cutting and threshing apparatus, as set forth.

"I also claim the mode of steering by pivot wheels, in combination with the reaping apparatus, as described."

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18. For an *Improvement in the Pump for Gauging the Quantity of Liquor to be Drawn;* Daniel Hunsicker, Hartleton, Pennsylvania, March 7.

The improvement claimed consists in connecting with the piston rod of a suction pump a sliding gauge, which, when set, determines the distance to which the piston shall move, and thereby measures the quantity of liquor to be delivered.

Claim.—"I make no claim to the pump, but only to the additional apparatus with it, by which it is adapted to the drawing of molasses, oil, and other articles in any required measure, by atmospheric pressure and lever power—that is to say, the scale, stop lever, slide, and spring."

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19. For *Improvements in Stop Cocks and Valves for Hydrants, and other purposes;* F. H. Bartholomew, New York city, New York, March 7.

The patentee says,—"The nature of my invention consists in an improvement in the construction of pistons for valves, or stop cocks, which, by the action of the water and atmosphere, shall close so gradually and gently as not to destroy lead pipe by concussion, and by which, also, when applied in combination with a plunger for hydrants, shall form a chamber, into which a portion of water in the hydrant may recede below the action of frost, and not waste into and saturate the earth."

Claim.—"What I claim as my invention and improvement, and desire to secure by letters patent, is the combination of the plunger with the piston or valve cock, in the manner used for the purpose described. Also, I claim the combination of the plunger and piston with the hydrant, substantially as described, said combination effecting the double purpose of checking the concussion from the water and of furnishing a variable chamber, in which the waste water may descend away from the influence of frost, and not waste away into the ground.

"I also claim the construction of the piston by which the aperture is closed before the full closing of the valve, and which, when combined with the plunger, shall furnish a variable chamber, for the purpose herein set forth."

20. For a *Machine for arranging the Blanks for Screws, or Pins, to deliver them to Machinery in which Wood Screws, or Pins, are to be manufactured;* Solyman Merrick, Springfield, Massachusetts, March 7.

The blanks are thrown promiscuously into a hopper, formed by placing a frustrum of a cone within an inverted frustrum of a hollow cone, the lower edges of the two being placed at such distance apart as to leave a space wide enough to receive the shanks of the blanks, but not the heads; and, therefore, when motion is given to the inner cone, it agitates the blanks, which drop in their places heads up, and carries them around to a slot, where they are delivered in succession, and in a proper position.

Claim.—"I therefore claim the combination of the conical hopper, one, or two, or more conic frustra, a partition, and a delivery apparatus, arranged and operating together substantially as specified. Also, the combination of the revolving beater with the conic hopper and one or more frustra, or other mechanical equivalents, the whole being disposed and operating together in the manner and for the purpose as above specified."

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21. For a *Process for procuring White Rosin and a pure White Spirit of Turpentine from raw Turpentine;* Nicholas U. Chaffe, Charleston, South Carolina, March 14.

The patentee says,—"The nature of my invention consists in the application of steam generated from water in a common boiler, and conducted by wood or metal pipes into a wood still containing the gum, which causes the spirits to rise and pass through a metal heater contained in a second wood still, and from thence to a worm, or condenser, from which is produced a pure white spirit of turpentine. After the spirit is off, the gum, or white rosin, is conducted into a metal vessel, under which a slow fire is kept, until the water is evaporated, when the rosin is transparent, or crystalized."

Claim.—"What I claim as my discovery and desire to secure by letters patent, is the manufacturing of white rosin and white spirits of turpentine from the gum of Pines, either dip or scrape, by the application of steam generated from water, in a common boiler, or still, and conducted through wood or metal pipes into a wood or metal still, mixing with the gum, and then passing through a metal heater, as herein described."

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22. For an *Improvement in Separating Grain from Straw when it leaves a Thrashing Machine;* John Blue, Covert, Seneca county, New York, March 14.

This improvement consists "in forming the endless belt, by attaching every alternate slat to two narrow endless belts of leather, and connecting the other slat to these, instead of attaching them directly to the leather belts, so that as each slat that is attached to the leather belts begins to pass up around the lower roller, the one attached to it is thrown open, or out of the curved line formed by the leather belts, and thus leaves a free discharge for straw, or any other substance that may have fallen through."

Claim.—"What I claim as my invention and desire to secure by letters patent, is forming the endless belt of slats, for carrying up and separating the grain from the straw, by attaching or jointing the alternate slats to those which are attached to the belts, or chains, which connect the whole together, substantially as herein described, to form openings for the discharge of straw, grain, or foreign matter, as herein described."

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23. For *Improvements in Carriages;* Starr Fairchild, Trumbull, Connecticut, March 14.

Instead of the usual perch and elliptic springs, and the fifth wheel on the fore axle, the fifth wheel is placed midway between the two axles, and the half of semi-elliptic springs extend from the rear axle to the lower plate of the fifth wheel, and in like manner from the fore axle to the other plate of the fifth wheel; and the former of these plates is also attached to the middle of reversed elliptic springs, the ends of which are secured to the carriage body; the whole constituting the springs and perch.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the fifth wheel, and springs, and stays suspended between the axles under the bodies of carriages, in the manner and for the purpose herein set forth."

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24. For an *Improvement in the method of Transporting, Washing, and Separating Coal;* John G. Brant, Cumberland, Maryland, March 14.

The broken coal is carried down an inclined shoot by a current of water, and this shoot is provided with branches and grates, so that the largest lumps, which are arrested by the first grate, pass into the first branch; the next size, in like manner, into the second branch; and so on, to the end; the water at the same time washing the coal, and carrying off the dirt and other impurities.

Claim.—"What I claim as my invention and desire to secure by letters patent, is conveying, washing, and separating coal simultaneously, by a current of water, in the manner above described, or other mode substantially the same."

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25. For an *Improvement in Dyeing Furs, &c.;* Denison Williams, Albany, New York, March 14.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the mode of dyeing or coloring furs, wool, and hair skins, herein described and set forth, viz: by stretching them upon horizontal nettings, frames, or smooth surfaces of any suitable material, and in this condition immersing the hair of the skins in dyes, either warm or cold, the object being to protect the skins from damage while the hair is acquiring the desired color."

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26. For an *Improvement in Tea Kettles;* Ezra Ripley, Troy, New York, March 14.

"This improvement consists in making that part of the spout which starts from the body of the kettle, to extend from the greatest diameter or bulge of the body up to within a short distance of the top, leaving only sufficient space between the top of the spout and the top of the kettle to give the necessary strength of metal, the sides of the spout being curved, so as to gradually run into the curve of the body of the kettle. By this form of the spout I am enabled to get the necessary area in the cross section of the spout to give the requisite strength to support a green sand core for the formation of the spout, so that the mould can be made in two parts, separated by a vertical plane passing through the middle of the body and spout. The two ears, to which the bale is affixed, are cast at the same time, one of these being a projection from the top of the spout. Another and important advantage arises from this mode of making tea kettles which cannot be attained by the old method, and that is, the glazing of the inside of the spout, to prevent the injurious action of oxidation."

Claim.—"What I claim as my invention and desire to secure by letters patent, is making the spout of tea kettles, at its junction with the body, to extend from the bulge of the body to within a short distance of the top, whereby, in moulding, the spout can be formed by means of a green, instead of a dry sand core, as herein described."

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27. For *Improvements in the Centrifugal Pump;* Wm. D. Andrews, New York, March 14.

These improvements are applied to the rotary pump that acts on the water by centrifugal force, and their nature will be clearly understood by reference to the

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the following parts, as applicable to the raising of water and other fluids, either alone or with an admixture of sand, gravel, or other substances. 1st. The vanes either straight and placed at right angles to each other, not radiating, but proceeding from the corners of an enlargement, increasing in depth as they approach the shaft,—or curved, proceeding from the centre, and increasing in depth as they approach the shaft. 2nd. The hollow cones inclosing the vanes and revolving with them. 3d. The joint formed by the fillet attached to the short pipe connected with the lower half of the revolving case, working within the stationary pipe attached to the outer case. 4th. The spiral passage of discharge constantly enlarging towards the exit."

28. For an *Improvement in the Stop-cock, or Faucet;* Thomas C. Clarke, Philadelphia, Pennsylvania, March 14.

Claim.—"What I claim as my invention and improvement, and desire to secure by letters patent is,—The introduction of a perforated valve, in combination with the main valve, for the purpose of more gradually stopping off the water, or other liquid, thereby preventing or lessening the liability of pipes bursting from the reaction of the stream when a strong head of water is too suddenly stopped off, as is the case in the common cock or faucet."

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29. For an *Improved Compound for Cements, and other purposes;* Wm. Yates and Dennis Dolan, Manchester, England, March 14.

The patentees say,—"The nature of our invention consists in the formation and compounding of a peculiar cement possessing the power of resisting fire and water, and also possessing a tenacity which renders it applicable to many useful purposes."

Claim.—"We claim as our discovery, or invention, 1st, the introduction of the tannin principle as an ingredient in our cement, as described; and 2nd, the mode of compounding such cement by pulverizing the portion containing the tannin principle, and the portion containing the gluten separate, and blending or mixing the two portions in a dry state, as described. We do not confine ourselves to the proportions mentioned, though we have found them to answer in practice for general purposes."

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30. For an *Improvement in the Horse Rake;* Seneca Ladd, Danville, Vermont, March 14.

The following extract, together with the claim, will enable those who are acquainted with the revolving horse rake generally used to understand the improvement.

"The object of making the beam to revolve, is to enable the person using the rake to discharge the hay or grain from it at any time, or to throw the teeth upward at any time and for any purpose. By simply elevating the upper end of the levers, the force of traction will cause the beam to revolve in its bearings, and thus throw the teeth upwards. As the beam revolves, the points of the auxiliary teeth will be brought into contact with the earth, and aid in completing the revolution of the beam."

Claim.—"I claim the above described mode of applying each of the teeth to the beam, or head of the rake, viz: by the joint spring and staple, in combination with each other, and acting together, as specified."

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31. For an *Improvement in the Horse Rake;* David Harkness, Raisin, Lenawee county, Michigan, March 14.

Claim.—"Having thus fully described the nature of my invention, in the manner of constructing the grain rake, what I claim as new and desire to secure by letters patent, is the affixing of the rake-teeth, or fingers, in a shaft, or head, which is made to turn on gudgeons in suitable bearings in rear of the axle in such manner as to cause said axle to become a fulcrum for elevating the collected grain, the respective parts of the machine being arranged for that purpose, substantially in the manner or upon the principle herein fully made known."

32. For an *Improved Method of Finishing Daguerreotype Miniatures;* Wm. A. Pratt, Alexandria, District of Columbia, March 14.

The patentee says,—"After having taken a picture according to the usual method, and having gilded it, I proceed, with varnish colors, (mixtures of different coloring substances with mastic or copal varnish,) to paint on the glass which is intended to cover the picture any design, such as clouds, plain black walls, curtains, chairs, couches, or any desirable accessaries; also, the working up the Daguerreotype itself to a degree of finish similar to oil painting, with the same colors; the laying the Daguerreotype on the glass, a complete juncture is formed, from the sticking or adhesion of the varnish color used; it is then submitted to pressure until perfectly dry, when I proceed, by the aid of nitric acid, to reduce or dissolve the copper backing to any desirable thickness; after this is done, any part of the picture may be cut away at the pleasure of the operator, and a new picture prepared as before attached."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the method, above described, of joining two or more portraits, or portions of portraits, and the producing artificial background on the glass, which, from their nature, cement *themselves* and the *glass* on which they are painted to the pictures, and which also enables the operator to produce any size picture that his glass will allow, even with a small sized instrument, which last has many advantages which will in course of practice suggest themselves; the whole producing a beautiful enameled appearance, and perfectly protecting the delicate picture from contact with air or damp."

33. For an *Improvement in Fan Blowers;* Isaac P. Smith, Orangetown, Rockland county, New York, March 14.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the various elements enumerated as entering into the construction and working of fan blowers, operated by auxiliary engines, for supplying the blast to the furnace of steam boilers; which elements consist of the increased diameter of the fan blower, and putting the fan directly on to the crank-shaft of the auxiliary engine; the combination of these two elements being essential to the end contemplated and attained by my improvement and invention, as above described."

34. For an *Improvement in the Abdominal Supporter ;* Edwin K. Gale, New York city, March 14.

The patentee says,—"The nature of my invention consists in applying a supplemental spring to the lower edge of the pad, to cause the principal pressure to be made at that point, thus raising all the viscera by an upward and inward force, caused by the compound action of the body spring with the pad spring—combined in a simple, permanent, and efficient manner."

Claim.—" Having thus fully described my improvement, I wish it to be understood that I do not claim the combination of a pad spring with the body spring, this having been done in several trusses ; but what I do claim as my invention and desire to secure by letters patent, is combining the body spring and pad spring, constructed as described, with the pad, substantially as herein described, so as to cause the pad, at its lower edge, to press inward and upward, while at the same time a freedom is given to adapt itself to all the motions of the body."

35. For an *Improvement in the Rotary Centrifugal Pump ;* Willis H. Johnson, Springfield, Illinois, March 21.

This pump consists of two or more disks on a vertical shaft, working in a case formed with a compartment for each disk, by rings that extend inwards to within such a distance of the shaft as to leave a passage for the water. The lower face of each disk is provided with radial, or curved ribs, or "paddle plates,"and the under surface of the rings or partitions of each compartment is armed with radial partitions, or ribs. The ribs, or "paddle plates," by the rotation of the disks, act on the water and force it towards the periphery by centrifugal force, and then over the disk, towards the shaft. The same action then takes place at the next disk, and so on, until the water is discharged at the top.

Claim.—" What I claim as my invention and desire to secure by letters patent, is the combination of the circular revolving paddle plates with the cylindrical ring plates and radial partitions, constructed, arranged, and operated in the manner and for the purpose set forth."

36. For an *Improved Ventilating Hat ;* Richard Halloran, New York, March 21.

A section of a spring hoop is hinged, by its ends, to the inside of the hat, and near the rim, and the bow part is connected to the front of the hat by a slide, so that the hoop shall rest on the head, while the forward part of the hat is elevated by the slide, to permit the circulation of air. Or an entire hoop may be substituted, and connected with the hat by several slides.

Claim.—" What I claim as my invention and desire to secure by letters patent, is the forming of a ventilating hat, or other analogous covering for the head, by means of hoops or bands, combined and operating substantially in the manner set forth."

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37. For an *Improvement in Lamps;* Samuel Rust, New York city, March 21.

This for an improvement in that kind of hand lamp in which a flat wick is moved up and down by a roller.

Claim.—"What I claim as new and useful in the lamp as above described, and desire to secure by letters patent, is the so bending or forming of the tube, and inserting it into the lamp, or stopper, as to place the edges of the tin, or material out of which the tube is made, on the centre or *middle part* of the *side,* and lengthwise of the tube opposite to the roller, so as to form a spring of the edges, or either of them, for the purpose of pressing the wick against the roller with a gentle pressure; and also I claim the projections, or narrow neck, or thin *space,* on the inside, and lengthwise of the tube in the centre or middle part of the wide, or flat side, (to be used either with the said edges which form the spring, as aforesaid, or to be used without,) combined with the roller in such way and manner, and for the purpose as above set forth, or in any other way that is substantially the same."

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38. For an *Improvement in Trusses;* Jacob Cooke and John Strickler, Strasburg, Virginia, March 11.

The patentees say,—"The nature of our invention consists in forming the pad in two parts, one of which is permanently affixed to the body spring, and the other, being jointed to the permanent part, is acted upon by a spring connected therewith, by which the local pressure is made much more effective."

Claim.—"Having thus fully described our improvement, what we claim as our invention and desire to secure by letters patent, is the combination of the pads, substantially in the manner and for the purpose set forth."

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39. For a *Combination of Matter for making Cream Nectar, or Vegetable Beer;* Simeon Whiton, Hartford, Connecticut, March 21.

The following are the ingredients and their proportions, viz:—ginger, 8 ounces; dried pumpkin, 4 pounds; pea nuts, or walnuts, 1 quart; sweet corn, 1 quart; cream tartar, 4 ounces; sugar, 10 pounds; essence of pipsissewa, 1 ounce; yeast, 6 gills; water, 20 gallons.

Claim.—"What I do claim as my invention and desire to secure by letters patent, is the combination of the four following ingredients, or either two of them, with the above, viz: cream tartar, pumpkin, nuts, and sweet corn, substantially as set forth in the specification, for the manufacture of vegetable transparent beer."

40. For an *Improvement in the Truss, or Abdominal Supporter;* Benjamin C. Everett, assignee of Benjamin W. Stratton, Philadelphia, Pennsylvania, March 21.

Claim.—"I do not claim the ratchet-hinge, as that has been before used, although under different arrangements. But what I do claim, is combining the ratchet-hinge with the truss pad and slide upon the flat spring, by which I gain the advantage of permanency of the pad and ease of adjustment."

41. For an *Improvement in the Truss, or Abdominal Supporter:* David B. W. Hard, Bethlehem, Connecticut, March 21.

Claim.—"What I claim as my invention and desire to secure by letters patent, is in forming a frame to my support, which constitutes a narrow outer margin, and which, in the general outlines of the form given it, presents three sides, one side towards the right, one side towards the left, and one side towards the pelvis. And I further claim, in combination with said frame, the mode of effecting support of the abdomen by means of a strip of cloth, or other pliable material, extended transversely, and in front of its lower portion, above the pubis and between the bones of the ilium, said cloth being attached, at its right and left extremities, to the two lateral portions of the said frame, hereinbefore described."

42. For an *Improvement in Windows;* James Ogden & Daniel R. Hart, Troy, New York, March 21.

Claim.—"Having fully described our improvements and their application, what we claim as our invention and desire to secure by letters patent, is constructing the windows of carriages in the manner described, having two or more divisions, or frames, with ledges at the top and bottom, so that by raising the lower frame all the others will be raised, in the manner and for the purpose set forth."

American Patents Re-issued in March, 1846.

1. For an *Improvement in the Running Gear of Carriages;* George Nichols, Trumbull, Connecticut, patent granted April 10, 1844, re-issued March 4, 1846.

The patentee says,—"The nature of my invention consists in affixing to the perch of a carriage (constructed of wood, steel, or other metal, of any convenient form,) two spring stay braces that extend from the spring bars, front and back, down to the centre of the perch, where they are so attached as to slide on the perch as the other end works up and down, which is effected either by bolts that pass through slots in the ends of the stay braces, by shackles, or any other method substantially the same."

Claim.—"I do not claim connecting the body of a carriage with the perch by means of longitudinal springs, as that has already been done;

but what I do claim as my invention and desire to secure by letters patent, is the combination of the spring stay braces with the perch, either by means of bolts passing through slots in the ends of said braces, in contact with the perch, or by any other analogous device, so as to allow the said braces to move thereon, substantially in the manner and for the purpose herein described."

2. For an *Improvement in the Method of Driving Shuttles in Power Looms;* Robert P. Cunningham, Abington, Vermont, original patent granted April 25, 1843, re-issued March 14, 1846.

The patentee says:—"The object of my invention is to save, in part, the waste of power, and to arrest the shuttle at the end of its course without occasioning the jar experienced in the method heretofore practised, and which consists in so forming the cams that operate the shuttle levers as to give them a retrograde movement, which commences before the shuttle reaches the picker, and which gradually retards it, in accordance with the law of mechanics, by which the momentum of a moving body can be arrested with the least resistance, that part of the shuttle levers which the cams act on being retained in contact by a spring or springs, or by other means."

Claim.—"Having thus fully explained the principle or character of my invention, and indicated the various modes of applying the same, what I do claim as my invention and desire to secure by letters patent, is forming the picker cams, substantially as herein described, to give the pickers a retrograde movement, gradually, for the purpose of arresting the momentum of the shuttle at the end of its course, as herein fully described."

3. For *Improvements in Machinery for Making Lead Pipe;* Benjamin, Jr., Henry B. & Geo. N. Tatham, of Philadelphia, Pennsylvania, assignees of John and Charles Hanson, of England; original patent granted March 29, 1841, re-issued March 14, 1846.

For an account of this patent, as originally granted, the reader is referred to page 346 of the 3rd volume, third series of this Journal.

Amended Claim.—"What we claim as our invention and desire to secure by letters patent, is the combination of the following parts, as described, to wit: the *core* and *bridge*, or *guide-piece*, with the *cylinder*, *the piston*, *the chamber*, and the *die*, when used to form pipes of *metal* under *heat* and *pressure*, in the manner set forth, or in any other manner substantially the same."

List of American Patents which issued in the month of April, 1842, *with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

(Continued from page 185.)

58. For a *Machine for Punching the Metallic Moulds of Buttons;* Alonzo C. Arnold, Norwalk, Connecticut, April 23.

The patentee says,—"The buttons to be formed consist of two circular plates of tin, or other metal. The outer one is flat, or convex, to suit the form of the button intended to be made, with a small rim round it, by turning its edge up at right angles. The other plate is for the back or inner part of the button, and is concave, having also a rim similar to the first, with a hole in the centre."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the entire combination, as described, of punches one within the other, operating in a die, as described, so as to produce the effect of cutting a circular piece of tin, of raising a rim round the edge, and of punching a hole in the centre when necessary, all by a single operation, which it has heretofore required three distinct operations to effect.

"I claim each and every part of said apparatus when combined, as above, to effect the above purpose. I do not claim the said combination, nor any part thereof, for any other purpose, except the punches, but I claim the outer and inner punches, operating in the same die, and the small punch which operates through the die, however they may be differently combined to effect said purpose."

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59. For an *Improvement in the Runner, or Upper Stone, of Mills;* Jos. H. Burrows, Cincinnati, Ohio, April 23.

Claim.—"I do not claim, as invented by me, the loading of a millstone with metal or other substance, or the use of a metallic eye, or bush for the same; but what I do claim as my invention and desire to secure by letters patent, is the manner of constructing the metallic plate, or back, in one solid piece, with its flanch or rim, which rim forms the upper band or hoop of the stone; and, also, of the manner of constructing the eye, or bush, so as to be of larger external diameter at its bottom than at its top, thereby forming a circular dovetail, to secure the stone in its place, in combination with the manner of securing the eye to the back by bolts, or otherwise, so as to form a firm and substantial stone; the whole being put together and combined in the manner substantially set forth."

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60. For an *Improvement in the Machine for Dressing Stone;* Theodore R. Timby, Auburn, New York, April 23.

In this machine, the block of stone to be dressed is placed on a permanent platform, and the sets of chisels, or cutters, are attached to a reciprocating carriage by a double set of racks and their necessary appendages. The upper surface of the stone is dressed by cutters on the ends of spring trip levers, and the edges by side cutters.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the arrangement of the horizontal side cutters, in combination with the vertical cutters operated by the springs, and the spiral cams for raising them; and I also claim the arrangement of the vibrating rack and bar, in combination with the parallel racks for throwing the carriage in and out of gear."

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61. For an *Improved Tool for Beveling, Chamfering, and Howeling Barrels;* Samuel Widerman, Ellysville, Maryland, April 23.

This tool is formed like the common block plane used by coopers, and has an iron face plate of the same curve, and a bit for cutting the bevel. Along the outer edge of the face plate there is a flanch which runs on the outside of the barrel, and near the inner edge another flanch, provided with a bit to cut the chamfer. and to this flanch is secured a block that carries the howeling cutter.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the chamfering and howeling apparatus with the block plane, in the manner and for the purpose herein described."

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62. For an *Improvement in the Spring Seat Saddle;* Foster D. Ward, Bellbrook, Ohio, April 23.

The webs are attached to a spring at the pommel, and the jockeys, with the seat above, each rest on a spiral spring that projects upward from the saddle-tree.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the forward spring and jockey, detached from the forward part of the tree, with the spiral springs under the seat, in the manner and for the purpose described."

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63. For an *Improvement in Metal Roofs;* Wm. Beach, Philadelphia, Pennsylvania, April 23.

The plates are all fluted; one of the side edges of one plate is turned up, and over it laps the edge of the next plate, which is beaded for this purpose, and in this way all the plates forming one range are connected. The upper edge of the lowest range is turned up, to form a ledge, over which laps the turned down edge of the next range, and so on to the upper edge of the roof. And each plate is secured to the wood of the roof by a single nail, that passes through a hole in a protuberance made thereon.

Claim.—"Having thus fully described the nature of my improvements in the formation of a covering of cast iron for the roofs of buildings, what I claim therein as new, and desire to secure by letters patent, is the combination of plates whose surfaces are fluted, in the manner set forth, in combination with the particular manner of joining them at their sides or edges, by the hollow bead and the respective ledges, formed as set forth; the whole being so arranged as that the surface of each plate will be on the same plane with its contiguous plates, laterally; and also, as making a part of the same combination, the manner of fastening the respective plates, by means of a single nail, or screw, passing through a hole in a protuberance made thereon, in the manner and for the purpose set forth. And I do hereby declare that I do not claim these devices otherwise than as they each make a part of this combination."

64. For an *Improved Method of Regulating the Height of Water in Steam Boilers;* Charles Clinton, Goshen, Orange county, New York, April 29.

Above the boiler there are two horizontal cylinders, of different diameters, opening into each other, to which are fitted two pistons attached to one rod. The outer end of the larger cylinder communicates with the steam of the boiler, to make pressure on the piston, and thereby force water contained in the small one through a pipe which extends down nearly to the bottom of the boiler. In this pipe there is a valve governed by a float, so that, when the water in the boiler sinks below the required level, the valve is opened and the water forced down by the pressure of the steam on the steam piston, which, being larger than the water piston, will have the preponderance, and so soon as the water rises in the boiler to the required height, the valve is closed, and the supply arrested. Should the water sink too low, the steam piston is forced to the extent of its motion, and beyond a vertical pipe through which steam issues to give the alarm.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of a steam and water cylinder, provided with pistons connected together, with the boiler of a steam engine, having a float arranged within it, as set forth, so that, by the combined action of the cylinders and float, a continuous supply of water is afforded to the boiler, or an alarm given when it ceases, all as herein described."

65. For an *Improvement in the Revolving Oven Cooking Stove;* Samuel B. Sexton, Baltimore, Maryland, April 29.

The oven used in this stove is a horizontal cylinder which turns in collars made in the end plates of the stove, the oven being provided with a circular rack, to admit of turning it at pleasure by a pinion and hand-winch. The outside flanch of the collars is of less diameter than the inner periphery of the oven, and to these are attached the oven shelf, bars, &c.

Claim.—"What I claim as my invention and which I desire to secure by letters patent, is the manner of supporting the revolving cylindrical oven on the circular collars; also, securing the ends of the shelf, rack, or bars, to the collars, as described."

66. For an *Improvement in the Spark Arrester;* A. Keagy & M. Shiner, Jr., Woodbury, Pennsylvania, April 29.

Claim.—"Having thus fully described the manner in which we construct our improved spark arrester, and likewise shown the operation thereof, we do hereby declare that we do not make any claim to either of the parts which we have described, taken individually, the whole of them having been used, under various modifications, in other instruments for the same purpose; but what we do claim, as constituting our invention, and desire to secure by letters patent, is the particular manner in which we have combined and arranged these parts, as set forth; that is to say, we claim, in combination, the employment of the perforated cone, and of the perforated zone through the outer case, the said cone and outer case being connected together by the curved rim; the upper end of the chimney terminating in the region of the perforated zone, and this zone being surrounded by a rim; the whole combination and arrangement being substantially the same with that set forth and made known."

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67. For an *Improvement in Liquor Cocks;* Charles A. Creasey, Philadelphia, Pennsylvania, April 29.

Claim.—"What I claim as a new manufacture in the above described cock, is the making it in part of cast iron, and in part of brass, in the manner set forth; that is to say, by casting the body, and also the key or plug, of iron, and then lining the socket, and covering the conical part of the key, with ferules of brass, or of some analogous metal; as fully set forth and made known."

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68. For an *Improvement in the Apparatus for Measuring and Cutting Garments;* Hiram Leger, Macon, Georgia, April 29.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the making and using of an 'apparatus (consisting of a combination of scales and the spirit-level,) for measuring and cutting garments,' as described."

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69. For an *Improvement in the Method of Making Sugar Moulds;* Antoine Carbonel, Philadelphia, Pennsylvania, April 29.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the before described mode of making sugar moulds, by giving to the cast iron lining mould a simultaneous vertical and horizontal movement over the cone, or core, for forming the cavity or interior of the article to be moulded, whilst the core or cone itself has a simultaneous horizontal movement.

"I likewise claim the mode of moulding sugar moulds by covering the core and the lining of the mould with paper, linen, or other material, to prevent the clay from adhering to them, as set forth."

70. For an *Improvement in the Bee Hive;* J. Milholland and B. Crane, Chandlersville, Ohio, April 29.

Claim.—"What we claim as our invention, and which we desire to secure by letters patent, is the construction and manner of using the boxes composing the bee house, as described."

71. For an *Improvement in the Cork, or Bottle Stopper;* Nath. D. Whitin, New York, April 29.

Claim.—"What I claim as my invention and wish to secure by letters patent, is the construction of the cork, or bottle stopper, in combination with a faucet, or stop-cock, for the purpose of forming a sort of imperishable cork, or stopper, by means of which, aerated fluids, such as porter, soda water, mead, small beer, &c., may be discharged in such quantities as may be desired, without the escape of the gas and consequent deterioration of the remaining contents of the bottle, or the removal and destruction of the cork, it being intended to refill the bottle through the stop-cock; in bottling soda water, the combined cock will be particularly useful in obviating the difficulty of stopping the bottle before too much gas escapes."

72. For *Improvements in the Percussion Lock for Cannon;* Enoch Hidden, of New York, and Samuel Sawyer, of Boston, Massachusetts, April 29.

The cock, instead of simply turning on the fulcrum pin, as in other locks, has an elongated hole, through which the pin passes, the cord by which it is operated being attached to the under side of the cock and passed around rollers, so that when the cord is drawn with a jerk, the cock, the moment it strikes the cap on the nipple, is drawn back from the touch-hole. The cock is adjustable, with reference to the touch-hole, by means of a set screw and projection on the body of the lock. The pad, or vent-stopper, is attached to the end of a spring that swivels on the lock.

Claim.—"What we claim as our invention and desire to secure by letters patent, is:—

"1st. Causing the cock, or hammer, to strike over the vent and instantly to recede therefrom, by means of the chase mortise in the cock, and the cord being suddenly jerked by the person firing the gun, in the manner before described, or in any other mode or method substantially the same.

"2d. The method of adjusting the cock to the vent, by means of the screw or projection on the body of the lock, as described.

"3d. The mode of fastening the lock to a gun that has no vent-field, by means of the pin, screw, and pins, as described.

"4th. The construction and arrangement of the vent-stopper, as described."

73. For an *Improvement in Piano Fortes;* Charles Bossert & John Schomacker, Philadelphia, Pennsylvania, April 29.

Claim.—"What we claim as our invention and desire to secure by letters patent, is the construction and arrangement of the hammer, so as to admit the lifter into the block, and act at a point on a line with its fulcrum, and its combination with the grand action, as described. We also claim the bridge, elevated above the pin block, in the manner and for the purpose described. We also claim, in combination therewith, the metallic bar having on it the projections, for the purpose set forth. We further claim the hinged hammer beam, or rail, combined and arranged as described."

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74. For an *Improvement in Stop-cocks;* Uel West & George Dobbs, New York, April 29.

The case of this stop-cock is conical, to which is fitted the key of the same form, having the water passages in it. The supply pipe is connected with the base of the cone at such an angle as to be in a line with the discharge pipe that is attached to the conical surface.

Claim.—"What the undersigned claim as their invention, is the combination of the two conical hollow cylinders, fitted together in the manner described, so as to form a perfect stop-cock, admitting the fluid at the base through its receiving pipe, and discharging it at its side through its escape pipe, or to be stopped and become water-tight, by turning the key, or inside cone."

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75. For *Improvements in the Cut-off Valves of Steam Engines;* Horatio Allen, New York, April 30.

Claim.—"1st. The combination of two slide valves, having their simultaneous motions in opposite directions, with a single movable seat containing two openings, leading respectively to opposite ends of the cylinder, as described. 2nd. The combination of the levers, or beams, which give simultaneous motions in opposite directions to two cut-off valves, with a rock shaft, or shafts, having bearings on movable supports; said valves being any valves which are at liberty to pass over or into the openings which they are intended to close, and said supports of rock shaft being such that they can readily be raised or depressed at pleasure, in the directions of the alternating motions of the valves, without interrupting their movements."

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76. For an *Improvement in Propelling Boats;* Philip C. Traver, Rhinebeck Flats, New York, April 30.

Claim.—"What I claim, and desire to secure by letters patent, is applying the water lifted, or thrown up, by the paddle wheels of steamboats so as to produce an auxiliary propelling power, in the manner described, or any analogous thereto."

77. For an *Improvement in Reaction Water Wheels;* Samuel B. Howd, Lyons, New York, April 30.

Claim.—"What I claim, and desire to secure by letters patent, is a mode of constructing a water wheel, commonly called a reaction wheel, by elevating it upon raisers placed between the disk of the wheel and the lower rim thereof, for the purpose of raising the upper surface of the lower rim to a level with the upper surface of the bottom of the cistern within the wheel, and for the further purpose of affording a channel of escape for the waste water rushing between the wheel and cistern, in the manner and for the purpose described."

78. For an *Improved Mode of Making Candles;* Ebenezer Marsh, Alton, Illinois, April 30.

The patentee says,—"The nature of my invention and manner of operating is as follows: About six ounces (the precise amount not material,) of strong nitric acid is added to a gallon of castor oil, and the same thoroughly mixed by stirring them together several times for the first twenty-four hours, then letting the same stand for six or eight days, or until it becomes sufficiently hard; or the process may be expedited by beating and stirring the same together when first mixed, and suffering it to stand until it becomes sufficiently hard. It is then shaved up fine and washed with water slightly alkaline."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the process, herein described, of hardening expressed vegetable oils by acids, for the purpose of making candles."

SPECIFICATIONS OF ENGLISH PATENTS.

Specification of a Patent granted to James Laming, *of the city of London, for an invention of improvements in making the cyanides and ferrocyanides of Potassium and Sodium,—being a communication from abroad.*—[Sealed, 18th November, 1845.]

The patentee, before describing the invention as communicated to him from abroad, has, for the better understanding of the improvements, detailed the chemical facts or principles upon which they are founded; these are as follow:—

1st. When animal matter, which contains nitrogen, as well as hydrogen and carbon, is exposed to a high temperature, not exceeding low red, an equivalent of nitrogen combines with three equivalents of hydrogen to form an equivalent of ammonia, and the carbon is separated.

2nd. When ammonia is exposed to carbon at a full red heat, an equivalent of ammonia exchanges two of its equivalents of hydrogen for two equivalents of carbon, and thus becomes prussic or hydrocyanic acid.

3rd. If free potassium or sodium be also present, the equivalent of ammonia parts with all its three equivalents of hydrogen, and the nitrogen which remains takes in their place two equivalents of carbon to form cyanogen, and one equivalent of potassium or sodium, as the case may be, to form a cyanide of the metallic base.

4th. When animal matter is exposed to heat, its temperature becomes gradually increased to low redness before it assumes that higher temperature indicated by a full red color; therefore, whenever animal matter is subjected to what is called destructive distillation, the formation of ammonia must take precedence, in point of time, to that of prussic acid or of the cyanides.

5th. When the oxide of potassium, or of sodium, or the carbonate of either of those oxides, is intimately mixed with carbon, and exposed to a heat approaching to whiteness, its metallic base is set free from the oxygen with which it was previously combined, and rises in vapor. If ammonia comes into contact with the mixture of carbon and alkali, or of carbon and alkaline carbonate, the separation of the metallic base from its oxygen takes place at a lower temperature,—under such circumstances, a full red heat being sufficient. In the case of the carbonates, the metallic bases, potassium and sodium, are liberated from the carbonic acid also, whenever they separate from their oxygen.

6th. Cyanide of potassium, or cyanide of sodium, by exchanging an equivalent of every three equivalents of its base for an equivalent of iron, is converted into the corresponding ferrocyanide, or what is called in commerce prussiate of potash, or prussiate of soda; and this change may be effected by causing the cyanides of the respective metals, dissolved in water, to come into contact with iron, or oxide of iron, in a state of division.

The ordinary way of combining potassium or sodium with cyanogen, preparatory to making the prussiate of potash, or prussiate of soda, for commerce, is to expose, in iron pots, an impure carbonate of one of those alkalies and animal matter to a red heat, and to trust for the necessary contact of the nitrogen and carbon of the animal matter with the metallic element, to the thorough incorporation of the ingredients of the pasty mass by stirring. While the temperature of the animal matter is approaching redness, ammonia is constantly being generated, and as it is volatile, it escapes and is lost; and this continues until the heat becomes great enough to convert the nitrogen and carbon of the animal matter into cyanogen, and to fix that cyanogen, by combining it with the metallic base of the alkali. Another source of loss is, the difficulty of causing the different elements contained in the pasty mass to combine; for, before each can be brought into contact with the other, by mechanical agitation, their temperature becomes elevated, and great part of the resulting nitrogenous gases, which are volatile, have time to escape. There is a third evil attending the ordinary process, namely, the proportion of carbon in animal matter, compared to its nitrogen, is greater than that in the alkaline cyanides; the greater part of this carbon, from its fixed nature, remains to solidify the mass from which the nitrogen so freely escapes;

so that it becomes necessary to suspend the addition of the animal matter, on account of the mass being too solid for the chemical action to go on, before enough of nitrogen has been combined to convert much of the alkali into prussiate.

Two patents have already been granted for methods of preventing the losses sustained in the ordinary way of making the prussiates of potash and soda. By one of these methods, the ammonia which is liberated from a heated mixture of alkali and animal matter, is conducted first over the surface of fused alkali, (the said alkali having no admixture of carbon,) and afterwards into a vessel containing a solution of alkali. The other of these methods directs that the ammonia, which results from animal matter exposed to heat, be made to pass upwards and downwards through a series of vertical pipes, arranged on the principle of inverted syphons, heated to redness, and charged with a mixture of charcoal, potash, and iron, reduced to small fragments. With regard to the former of these methods, it is well known to chemists that fused alkali has no power of decomposing ammonia into cyanogen unless carbon be present; and with regard to the latter method, it is obvious that, as the materials, if brought into a state of fluidity or pastiness, must, of necessity, choke the passage of the pipes, the method demands that the mixture in the inverted syphons be kept from losing its solid or granular state; and the continuance of that state is secured by the large proportion of infusible charcoal compared to the fusible potash, which the patentee prescribes, as fulfilling his intentions in a satisfactory manner.

Now, under the present invention, the patentee makes use of charcoal, or other form of carbon, in powder, mixed with one of the alkalies, or its carbonate or other salt, capable, under the circumstances, of surrendering its metallic base to cyanogen. This mixture is constantly maintained in a fused state, so as to be fluid, or at least in a pasty condition, which is highly favorable for converting the metallic base of the alkali, or its salt, into a cyanide, and which takes place rapidly under such circumstances, when a current of ammonia gas is introduced to the fused mixture. The metallic base of potash, or soda, or of their compounds respectively, as the case may be, is liberated by the agency of the heated carbon, assisted by the affinity of the metallic base for the cyanogen, which is at the same time formed by the combination of heated carbon with the nitrogen of the ammonia; cyanide of the metallic base is thus produced, and this product is constantly augmented in quantity (the current of ammonia being continued) until great part of the alkali, or other compound of its base, has become converted into cyanide. When an alkaline carbonate is used, powdered charcoal, to the amount of more than 30 per cent. of its weight, may be added, without destroying the fluidity of the mixture if the temperature is raised to a full red. When the potash or soda is in a caustic state, a larger proportion of charcoal may be added; or, what is more advantageous, the mixture will remain fluid, although the heat be raised not so high. Whether the ammonia gas is passed through the mixture of carbon and fused alkali, or other compound of its metallic base, (which is preferred,) or over its surface, it is better to have more than one vessel charged with the heated materials, and so connected together by pipes, that the nitrogen of the ammonia, which escapes the chemical reaction in the first vessel, shall not pass through the whole series without combining. The apparatus thus acts on the principle of a series of Woolfe's bottles, and according to this invention all the vessels are made red hot, except the last, into which water, or some liquid convenient for arresting the vapors of alkaline metal, is put; or otherwise the vapors might be lost. The first product, as in the common process for making prussiate, is a cyanide of the alkaline metal present, which may be dissolved out from the mass, technically called "metal," by boiling the latter in alcohol, of about 0·896 specific gravity, from which, filtered hot, it spontaneously separates, in great part, on cooling. To obtain the ferrocyanide, the metal is to be treated in the usual way, namely, its soluble parts dissolved in water, then treated with iron, the solution evaporated, and, when sufficiently concentrated and clear, set aside to crystalize; and the rough product is afterwards purified by re-crystalization.

The patentee states that he does not claim the invention of any process for dissolving out or obtaining either cyanide or ferrocyanide from the compound termed "metal;" nor does he claim the construction of apparatus wherewith the process or processes may be carried on; but he describes some arrangements which have been found to answer. One of these consists of three iron air-tight covered pots, communicating with one another in the manner of ordinary Woolfe's bottles: that is to say, the induction pipe of the first pot reaches to near its bottom,—its eduction-pipe reaches down the interior of the second pot to near its bottom,—and the eduction-pipe of this second pot terminates in like manner in the third pot; while the eduction-pipe of the latter plunges beneath the surface of some water, or other liquid, convenient for oxidizing and arresting vapors of alkaline metal. Each of the pots has a man-hole in its cover, by means of which it may be charged and discharged, and a door, by which it may be perfectly closed. Each covered pot is so set in a furnace as to be heated to a temperature great enough to keep its contents in a state of constant fusion. Its charge, when fused, should about half fill it. By the use of this apparatus, the ammonia which is forced into the first pot, by reason of its own elasticity under the pressure attending its assumption of the gaseous state, passes through the fluid mixture of fused alkali and carbon in that pot,—being there decomposed into nitrogen or cyanogen, and, as cyanogen, combining with and saturating the alkaline metal present; after which the ammonia or its nitrogen or uncombined cyanogen, which results from its action on the carbon, still remaining in that pot, passes into the second pot, to convert the alkaline metal there present, into a cyanide. In like manner, the ammonia, or its nitrogen, or the resulting cyanogen, may arrive in the third pot; then is the time for stopping the operation, in order that the two first pots may be emptied and re-charged. Owing to the volatility of the alkaline metals at high temperatures, the pipes of communication between the pots are apt to become obstructed; for this reason they are proposed to be made straight, and joined together at right angles, in such a manner that by removing a screw-plug from the end of each rectilinear piece, the passage through it may be cleared by passing into it a short rod of iron ; in order that this process need not be often repeated, the diameter of the pipes should be as great as convenience admits of.

The patentee next describes a modification of the preceding apparatus, wherein no pressure is required to overcome the resistance opposed to the current of ammonia by the fluid mass into which the induction-pipes of the preceding apparatus are immersed. In this modification all the induction-pipes stop short at the covers of the pots, except that of the open pot, which may be allowed, without much inconvenience, to dip below the surface of the water, or other liquid, intended to arrest the metallic vapors.

The ammonia gas, in this case, urged forward by an inconsiderable amount of pressure, comes into contact with the surfaces of the fused ingredients in the several pots in succession, until it is either decomposed and its nitrogen absorbed, as in the preceding case, or escapes by the last eduction-pipe of the series; to prevent which, either the number of pots may be increased, or, what is better, each of the three should be furnished with agitators, moved by machinery or labor. When the latter arrangement is adopted, each pot should be furnished with a lofty conical cover, containing, at its apex, a stuffing-box, in which the axis of the agitator turns, and which is kept sufficiently cool by a stream of water running through a small cistern, which embraces the stuffing-box. With this apparatus, the fused ingredients may be either in a fluid, semi-fluid, or pasty condition.

The patentee claims the making of the cyanides and ferrocyanides of potassium and sodium; or, as they are called in commerce, prussiates of potash and soda, in any suitable apparatus, by passing ammonia (either pure, or mixed with such other gases as do not prevent the desired result,) over the surface, or through the mass (according as the induction-pipes may dip or not below the surface) of potash, or soda, or other compound of potassium or sodium, (capable, under the circumstances, of setting free its metallic base,) in a state of fusion by heat, and mixed with charcoal, or other form of carbon, in powder, and in such proportion as to be adequate to effect, without destroying by its bulk, the fluid, semi-fluid, or pasty condition of the resulting mass. And, further, he claims, for the process or processes of this invention, the sole use of ammonia, or mixture, or combination of ammonia with other gases or vapors, whatever be the source from which it is obtained; provided, always, that in such mixture or compound there be no substance present capable, by its nature, of preventing the desired result. He claims, for example: the application to this invention of ammonia, or carbonate of ammonia, obtained from gas-water, from urine, from the liquor condensed in the distillation of bones or other animal matter, or from one or other of the salts of ammonia, or a solution of ammonia ; and also the ammonia, or carbonate of ammonia, which is obtained directly, mixed with other gases, in the carbonization of bones and other animal matters, and in the chemical treatment of guano. Whatever be the source from whence the ammonia is obtained, it is desirable that it should be made as free from the vapor of water as possible before it is introduced to the fused materials; for this purpose the substances from which it is to be eliminated may be dried, or else the ammonia may be passed, in an elastic state, in contact with some substance known to chemists to be convenient for desiccating that gas.

Instead of obtaining the ammonia by a separate process, or from a distinct vessel, the inventor sometimes causes it to be given off from animal matter contained in the vessel or vessels in which the cyanide is formed. For this purpose it is better to use the potash or the soda in a caustic state, causing it, while in that condition, to dissolve the animal matter. The following is the mode of proceeding:—A caustic solution of alkali, in water, or other convenient liquid, is first made boiling hot, and to it, while boiling, as much animal matter is added as it will readily dissolve; the solution is next evaporated to dryness, and the mass preserved in that state for use. When a portion of this mass is put into each of the heated vessels, except the last, of such a series as has been described, and the last heated vessel is charged with carbon, mixed with some convenient compound of an alkaline metal, as before stated, then the ammonia which escapes from any one of the vessels in the series, will have to pass through one or more subsequent vessels, and thus tend to suffer decomposition; the resulting nitrogen being converted into cyanogen, and then being absorbed. This admits of the cheaper kinds of animal matter being used,—such as the undried flesh and viscera of carrion, and old woolen flock and rags, which, by reason either of humidity, or too great volume, cannot conveniently be mixed in their natural state with red hot alkali. The patentee claims this modification of the process as part of the invention for which this patent has been granted. Sometimes the mass resulting from the desiccation of the solution of animal matter in caustic alkali is put into red hot open pots; in this case, much ammonia is lost, but the improvement which is introduced by replacing the ordinary mechanical admixture by an intimate chemical combination, affords a greater product in prussiate than can be obtained from an equal quantity of animal matter treated in the ordinary way.—[*Inrolled, May,* 1846.] Lond. Jour. Arts & Sci.

Specification of a Patent granted to William Greener, *of Birmingham, and* William Edwards Staite, *of the county of Surrey, for improved means of ignition and illumination.*—[Sealed, 7th February, 1846.]

This invention consists in obtaining light by means of solid prisms or cylinders of carbon enclosed in air-tight vessels of glass or other transparent substance, which prisms, when acted on by currents of voltaic or magnetic electricity, are rendered luminous; (the carbon being previously freed from impurities, and divided on the surface into numerous acute points;) or rods or strips of platinum, or other metal not easily fused, when divided on the surface into numerous acute points, and enclosed in transparent air-tight vessels, may be employed, together with currents of electricity, for producing illumination. The invention also includes the employment of hollow cylinders of carbon, either plain or acuminated, partially inserted within, and brought into perfect contact with hollow cones of platinum, either plain or acuminated; the whole, being enclosed in transparent air-tight vessels, are rendered luminous by electric currents.

Carbon and platinum have been before used for the above purpose; but the patentees state that carbon has been found to give out various extraneous matters, which interfere with the continuity of the light, and darken the glass vessel by deposits on the inside of the same; and from plain surfaced platinum only a feeble light has been obtained. In order to obtain carbon perfectly pure, or as nearly so as possible, the patentees digest a quantity of lamp-black, or pulverized charcoal, or pulverized coke, (which has been purified from sulphur and other matters by the application of electricity, according to the method patented by J. Church, December 20, 1845,) in dilute nitro-muriatic or other acid; it is then strained from the acid, and washed several times in water; it is next washed in a weak alkaline solution; and, lastly, in distilled water, until no traces of impurity are perceptible. The purified carbon is thoroughly dried, and then converted into prisms or cylinders by means of an hydraulic or screw-press, in the same way as the porcelain buttons are made; and sometimes, to insure perfect dryness and homogeneousness, the prisms or cylinders are exposed to an intense heat in a furnace for about twenty-four hours. The numerous acute points are formed on the surfaces of the prisms or cylinders by means of a saw, or by casting them in suitably-indented disks. The advantage obtained by opposing two such acuminated surfaces, the one to the other, is, that should the electric current cease between any two points, (as frequently happens in the ordinary mode of igniting carbon by electricity, when there are only two points in opposition,) the current will be kept up by the remaining points, and the light maintained without any material interruption or abatement. In some cases a number of thin strips of charcoal, separated from each other by platinum foil, and bound together with platinum wire, are substituted for the bodies with acuminated surfaces; and sometimes, instead of employing either lamp-black, charcoal, or coke, plumbago or black-lead is prepared, formed, and used in the same way.

When platinum, or other difficultly fusible metal, is used as the illuminating medium, the number of separate points on its surface are multiplied as much as can be conveniently effected; and, for this purpose, the patentees either perforate a sheet of the metal with a great number of minute holes, or take it in the form of wire, and weave it into a gauze sufficiently thick to bear the heat produced by the electric current without fusing. When hollow cylinders of carbon are employed in combination with hollow cones of platinum, they are arranged in the following manner:—The two wires from a voltaic battery are each connected with a hollow cone of platinum, either plain or acuminated, and the cones are placed with their bases facing, but at a short distance from each other; the cones are then connected, by placing between them a hollow cylinder of carbon, either plain or acuminated, and inserting it so far into them as to be in perfect contact therewith all round. Such cones and cylinders may be used either in single sets, or in any number of sets which the battery or batteries employed, may be adequate to supply. When the illuminating medium is placed in the transparent air-tight vessel, it may be either kept stationary or made to rotate.

The patentees claim, Firstly,—the employment, as a medium for the development and exhibition of electric light, of carbon, purified and prepared as above described. Secondly,—the employment, for the said purpose, of carbon and platinum, or any other like difficultly fusible metal, in solid prisms or cylinders, divided on the surfaces thereof into numerous acute points, or in such other forms as to present numerous acute points, as above described. Thirdly,—the employment, for the said purpose, of hollow cylinders of carbon, either plain or acuminated, in combination with hollow cones of platinum, or other like difficultly fusible metal, either plain or acuminated, as above described.—[*Inrolled, August*, 1846.] Ibid.

Specification of a Patent granted to TIMOTHY KENRICK, *of the county of Stafford, iron-founder, for improvements in glazing and enameling the surfaces of cast iron.*—[Sealed 26th May, 1846.]

This invention consists in enameling the surfaces of certain cast iron articles. The vessel of cast-iron required to be glazed and enameled, must first be well cleaned; it is then ready for the application of the enamel, which is composed of two coats, one forming the body, and the other producing the glaze. The first composition is made by fusing 100 lbs. of calcined flints, ground to fine powder, with 75 lbs. of finely pulverized borax, and then grinding 40 lbs. of this mixture with 5 lbs. of potters' clay, in water, until it is brought to such a consistence that, when the cast iron vessel is dipped into the composition, it will receive a coating about one-sixteenth of an inch thick. As soon as the coating, thus applied, has become set, and while it is yet moist, the second composition, which is in a finely pulverized state, is sifted over it. The second composition is formed by mixing together 100 lbs. of Cornish stone, ground to a fine powder, 117 lbs. of finely ground borax, 35 lbs. of soda-ash, 35 lbs. of saltpetre, 35 lbs. of sifted slaked lime, 13 lbs. of white sand, and 50 lbs. of well-pounded white glass, and vitrifying the mixture; when cool, it is ground very fine in water, and afterwards dried; 45 lbs. of the powder and 1 lb. of soda-ash are well mixed in hot water, by stirring; and the mixture being then dried in a stove, a fine powder is produced, which constitutes the second composition. When this powder has been very evenly sifted over the first composition, the cast iron article must be put into a stove kept at a temperature of about 212° Fahr., in order to dry the composition; after which, the composition is fired, by placing the article in a kiln or muffle, kept at the temperature requisite to fuse the glaze. If the article is found to be imperfectly glazed, when withdrawn from the kiln, some of the glazing composition is again sifted over it, and it is replaced in the kiln until the glaze is fused.

For coating the inside of iron pipes, over which the glaze-powder cannot be conveniently sifted, on account of their length or small diameter, the patentee proceeds in the following manner:—When the inside of the pipe has been cleaned, he pours the first composition through it, turning the pipe round at the same time, to insure an even coating upon every part; after this has become set, he pours the second composition through in a similar manner, and then fires it in a kiln, as above mentioned.

The patentee, in concluding his specification, says, that the interior surfaces and rims of cast iron vessels have been heretofore enameled and glazed by the application of two-coatings, one for the body, and the other for the glaze. He therefore claims, Firstly,—the enameling and glazing, in the manner above described, of the exterior surfaces only of such vessels of cast iron. Secondly,—he claims the enameling and glazing of cast Italian-irons, cast box-irons, and cast iron knobs for doors and other purposes. Thirdly,—the enameling and glazing of the inside of such cast iron pipes as aforesaid. And, Lastly,—the enamel and glazing of the ornamental surfaces of cast iron.—[*Inrolled, November,* 1846.] Ibid.

FRANKLIN INSTITUTE.

Committee on Science and the Arts.

Report on Apparatus for Double Seaming Tin-ware, &c.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred, for examination, a Machine for Double Seaming Tin-ware, &c., invented by Mr. George R. Moore, of Philadelphia, Pennsylvania, Report:—

That, upon examining the machine, they find it simple in its construction, and in many respects similar to those used for swedging and burring.

The most essential points wherein it differs from other double seaming machines, consist in the peculiar form of the heads, or dies, combined with a small roller running at an angle of about 45 degrees with them, for the purpose of keeping the work in its place during the operation of turning down the seam.

Also a sliding gauge, for holding in a proper position any flaring article, all of which are fully explained in the drawing and specification herewith submitted.

These features embrace all that is claimed by Mr. Moore, as new, and for which he has obtained letters patent.

The committee have devoted considerable time and attention to ascertain, as correctly as possible, the practical working of the machine, and for that purpose had it tried by different workmen, and the result, in every instance, was entirely satisfactory; and, in addition to their own observation, they have been favored with the testimony of several highly respectable manufacturers, in whose establishments they are now successfully used.

These facts induce the committee to recommend the machine to the favorable notice of manufacturers of tin-ware.

By order of the Committee,
William Hamilton, Actuary.

Philadelphia, March 11, 1847.

Description (extracted from the letters patent) of a Double Seaming Machine, invented by Geo. R. Moore, *of Philadelphia, Pennsylvania, dated September* 19*th*, 1846.

Reference is had to the accompanying drawing, which presents a front view, and makes a part of this description.

All the parts that are not lettered compose the frame simply, the construction of which is obvious from the drawing, as it is similar to other tin machines, and made of the same materials; it may, however, be varied.

Fig 1.

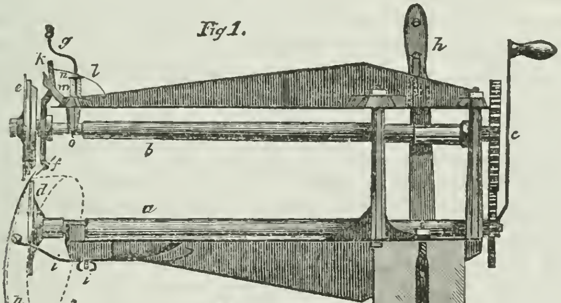
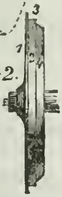
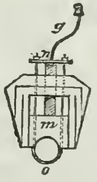
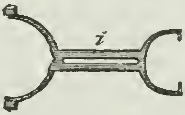


Fig 2.







I proceed to describe the working machinery, noticing first the two arbors, *a*, and *b*, which are connected by cog wheels, and turned by the crank, *c*. Two heads, *d*, and *e*, are affixed to the ends of these arbors, and between these heads the double seaming is performed. A pan, *p*, is represented in dotted lines, as placed over the head, *d*, on the lower arbor, so as to bring the edge which is to be seamed down between the head, *e*, and a small roller, *f*, hereafter described. The shape of the head, *e*, should be carefully noticed. This head consists of a flanch, 1, projecting from a cylindrical surface, 2, similar to some other machines now in use; this cylindrical surface is terminated by a shoulder, 3, that connects with a conical moulding, 4. The bevel surface of the head, *e*, bears first upon the edge of the pan, which is sustained by the head, *d*, the shoulder, 3, above named, coming against the bottom, and the edge is forced to yield to the bevel of the head, *e*, as this is screwed down upon it by means of the screw, *g*, and should any part of the edge be inclined to slip out towards the top of the pan, (as this edge is always composed of three thicknesses,) it is prevented from so doing by the little roller, *f*, attached to the collar, *k*, that surrounds the arbor, *b*, near the head.

At this stage of the operation, the crank, *c*, is turned, the pan revolves in the machine, and the edge is turned down as far as the bevel part, 4, of *e*, will turn it, while the shoulder, 3, prevents the edge of the pan from bending too far down towards the centre; after this, the head, *e*, must be raised up a little by turning the screw, *g*, attached to the box, (in which the arbor, *b*, runs,) and then the lever, *h*, is brought into use, to move the arbor, *b*, inwards, by which the cylindrical part, 2, of the head, *e*, which is parallel with the outer surface of the head, *d*, is brought over the same and then screwed down towards it, by the screw, *g*, when, by again turning the crank, the work is completed. The outside shoulder, 1, of the head, *e*, keeps the bottom of the pan close against the head, *d*. The lever, *h*, passes through an aperture in the frame, where it has room to be moved back and forth, and places are fitted to receive it when so moved, into which it is thrown by a spring, or by its own elasticity. It also passes between two shoulders on the arbor, *b*, and its lower end is connected to the frame by a pivot. Its use has already been explained. *i*, is a sliding gauge for the purpose of holding in proper position flaring articles, such as the pan represented in the drawing, where the bottom needs to be thrown out from a perpendicular with the arbors, in order to bring the body parallel with them. This gauge consists of a shank that is attached, by the screw, *j*, to the frame, and is terminated by heads branching out for the bottom of the pan to rest against, upon the inside. This is found to be indispensable when the work is much flaring. The heads of this gauge are provided with soft or smooth surfaces, to prevent them rubbing the tin so as to mar or injure it. When it is not desirable to use the gauge, the work will rest against the head, *d*, which is faced nearly to the edge with leather, although other materials may be used, to prevent its rubbing the tin.

The piece, *k*, is a collar with a lever attached thereto, the collar part of it is fitted upon the arbor, *b*, allowing the arbor to turn freely in it, while the upper end passes through a loop, *m*, in the frame, to keep it in an upright position, and below the collar, this lever passes through the little roller, *f*. The only use of the loop, *m*, is to bring the roller, *f*, to bear properly upon the work, and to secure this the better, the lever, *k*, is made crooked at the top, so that, by pressing it down, this part of it is brought towards the frame, and consequently the roller, *f*, is moved up closer towards *e*, and *vice versa*.

A spring, *l*, is applied to throw *k* back, as it rises up, to make it easy to get the work properly into the machine.

The screw, *g*, is so connected with the arbor, *b*, by means of a bow and yoke, that both are raised or lowered at pleasure.

What I claim in this invention is the combination of the roller, *f*, with the head, *e*, constructed and arranged substantially in the manner and for the purpose set forth.

I further claim the combination and arrangement of the gauge, *i*, in the manner and for the purpose heretofore described, supporting the inside of the vessel at the bottom while being operated upon, when the sides thereof are flaring.

And lastly, I claim the employment of the shoulder, 3, which terminates the base of the conical part of the head, *e*, to keep the bottom in place while making the first bend, as above described.

Report on a Wicket-gate for Canal Locks.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the plans and model of a Wicket-gate for Canal Locks, invented by F. C. Lowthorp, Esq., C. E., of Pennsylvania, REPORT:—

That they have examined the plans and models of Mr. Lowthorp, and have had the benefit of his personal explanations.

They submit herewith a drawing of the apparatus, and a description furnished by the inventor, which refers, by letters, to the different parts of the drawing. There is also in the possession of the Institute the original working model, constructed by Mr. Lowthorp, on a scale of one inch to a foot, which was tested at Mauch Chunk, where it was attached to the fore-bay of a mill that furnished a constant head and an abundant supply of water for the experiments, which are said to have been very successful. The committee experimented with a small brass model, somewhat differently arranged, which was intended for the Patent Office, at Washington. In it the top and one side were made of plate glass, so as to exhibit clearly the interior arrangements and movements of the parts. It was attached to a reservoir four feet deep, filled from a hydrant. It worked very satisfactorily, the large wicket being under perfect command, and being capable of being set in motion or stopped at any angle desired, without causing any shock.

The object of the apparatus is to draw water rapidly from a higher level to a lower; for example, to fill or empty lock chambers, or to draw off a canal level, mill race, or reservoir of any kind.

This is effected by an ingenious application of hydrostatic pressure. In the effluent sluice is placed a gate, or wicket, with two leaves at right angles to each other, having a cross-section like the letter L, one leaf being longer than the other. This gate works upon pivots, or a hinge, at the angle of intersection of the two leaves, and at one side of the sluice. The shorter leaf of the gate is of proper dimensions to close the sluice when the flow of water is not required. This leaf is kept shut by the pressure of the head of water, which produces no effect upon the longer leaf so long as it is admitted freely to both sides of it.

When the sluice is to be opened, the water is drawn from one side of the longer leaf, and immediately the pressure upon the other side preponderates against the shorter leaf, and forces it open.

The opposite effect is produced by admitting the water to both sides of the longer leaf, when the pressure upon the shorter leaf again closes the sluice.

These alternate effects are produced by two small turning wickets at right angles to each other and coupled together, which are moved simultaneously by a single lever.

For the details, the committee refer to the annexed description and drawing, without which, they would be unintelligible.

In the model and plans, the small wickets are on a scale representing fifteen inches square, and the sluice is three feet wide and five feet high, having an opening of fifteen square feet. The time and effort required to manœuvre the small wickets will certainly not be greater than is necessary to work one of the simple turning wickets generally used in lock gates, while the quantity of water discharged by the sluice will, with the above proportions, be about four-fold, and may, by a variation of the relative dimensions of the parts, be greatly increased.

In conclusion, the committee will observe, that, in some important particulars, the apparatus under consideration resembles the very ingenious device invented by Josiah White, Esq., and known as the "Bear-trap Sluice." It is probable, indeed, that the original idea was suggested by that contrivance, with which the Institute is familiar.

In the application of the same general principle, however, and in the details, as well as the uses to which "F. C. Lowthorp's wicket-gate" is applicable, the committee recognize originality and ingenuity worthy of praise, and they commend the invention, to those having important hydraulic works to construct, as deserving of their attention and investigation.

By order of the Committee,

William Hamilton, Actuary.

Philadelphia, March 11, 1847.

Description of F. C. Lowthorp's Wicket-gate for Canal Locks.

Fig. 1 is a plan, in which the part A, is intended to represent a reservoir, lock-chamber, &c. *a*, *d*, shows the leaves of the "wicket-gate," (which is supposed to be placed in the side wall of a lock,) both of which are secured to the shaft, *s*, and are connected by means of the rods, or bars, *p*, *p*. H, is a recess, or chamber, into which the leaf, *d*, moves in opening the leaf, (or gate,) *a*. *i*, *o*, are small valve-gates, (so connected, or coupled, *that both may be turned at the same time*, the one opening, and the other shutting,) used for emptying and filling the chamber, H, and may be worked as shewn in the plan and sectional views, (see figs. 1, 2, and 3,) or otherwise. *c*, *c*, is a channel, or pipe, communicating with the water in the (lock-chamber, or) reservoir, A, and the chamber, H, through the valve-gate, *i*. *g*, is a grating intended to prevent the channel, *c*, *c*, from becoming obstructed. *n*, *n*, is a channel, or pipe, communicating with the chamber, H, and the lower level, through the valve-gate, *o*. *m*, is a man-hole in

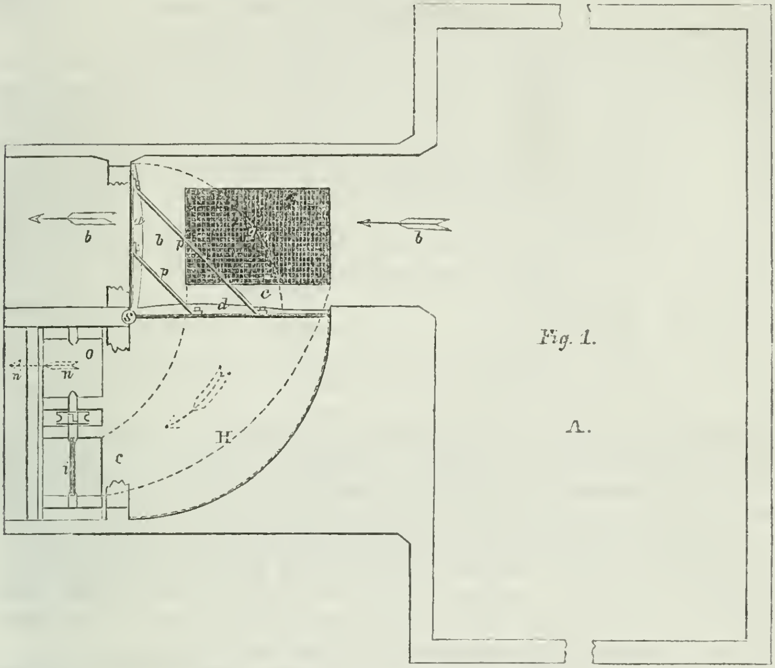
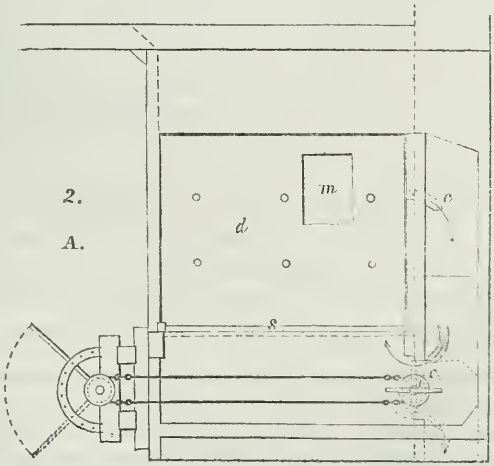


Fig. 1.

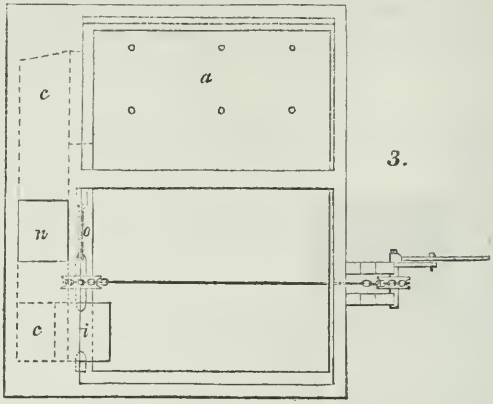
the leaf, *d*, for the purpose of getting at the small valve-gates *i*, *o*, for repairs and other purposes. *b*, *b*, *b*, shows the water-way communicating with the reservoir and the level below.

Fig. 2 is a longitudinal section of the plan, or fig. 1.



2.

Fig. 3 is a cross section of the same.



3.

The plan represents the wicket-gate as closed, and the lock, as well as the chamber, H, full of water. When it is desired to empty the *lock*, the valve-gate, *o*, communicating with the lower level through the channel, *n*, *n*, is opened; at the same time, the valve-gate, *i*, (which is connected with the same,) communicating with the lock-chamber, through the pipe, *c*, *c*, is closed; the water is thus discharged from the chamber, H, and the pressure of the water acting on the larger leaf, *d*, forces the (gate, or) smaller leaf, *a*, open. The water in the lock-chamber is then discharged through the passage, *b*, *b*, *b*.

The inventor does not propose to confine himself to the precise mode of construction shown in the plan, but purposes availing himself of different modes of construction to suit different localities where gates for discharging water are used; the principle remaining the same, which consists in alternately applying and relieving the pressure from one side of the larger leaf (arm, or paddle) of a wicket-gate, thereby causing it to turn one way or the other, so as to force the other leaf of the gate open or shut, as may be desired; both leaves of the (valve-gate, or) wicket-gate being secured to, and made to turn on, or with, the same shaft, or axis; the shaft being placed in a vertical, horizontal, or in any other position desired.

BIBLIOGRAPHICAL NOTICE.

The Literary World: A Gazette for Authors, Readers, and Publishers. Edited by E. A. Duyckinck, Esq., *and Published by* Osgood & Co., 136 *Nassau Street, corner of Beekman, N. Y.*

We have received several numbers of "The Literary World," a new periodical published weekly, in quarto form, in the city of New York, at three dollars per annum. Its general plan is similar to that of the London Athenæum, which we have long looked upon as one of the most interesting and valuable of our exchanges. The tone of the criticisms contained in this new candidate for public favor is good, its reviews of new books are marked by good sense and good taste, and it has our best wishes for its success.

The vast increase of our population, combined with its restless activity, and the extension of the intercourse of all parts of our country with each other and with foreign countries, call for corresponding efforts on the part of our citizens to sustain such of their own periodicals as are conducted so as to be worthy of permanent support. The great difficulty of sustaining, for a series of years, a scientific or literary journal in our country, is well known to those who have made the attempt; and yet the Americans are emphatically a reading people, and ever anxious to extend their knowledge of what is going on in the world. One cause of this difficulty is excess of competition, which divides and subdivides both the efforts of those by whom such works are conducted, and the patronage of the public, by which they must be maintained. No sooner has a scientific or literary journal struggled into a position which promises a continued existence and the possession of a field of usefulness of respectable extent, than a rival starts up to contend with it for a part of that patronage, which is barely enough for one, and altogether insufficient for two. The result too often is that both fail. The right remedy is an extension of public favor to those American journals which have maintained, for years, a high character, or to those newly established which are original in their aims, or conducted with marked ability.

MECHANICS, PHYSICS, AND CHEMISTRY.

Extract of a letter from Philos B. Tyler *to the Actuary of the Franklin Institute.*

Sir,—I have always wondered, when reading the advertisement of your Committee on Publications, that more observations of practical men were not communicated for publication; but I suppose they have, like myself, feared that matters which appeared interesting and important to themselves, might be common-place and uninteresting to others. I have a great desire to be useful in my sphere, which, together with my interest in the Institute, has induced me to communicate the enclosed observations to your Committee, begging that they will use them in any manner which they think proper, my only object being to communicate information.

Respectfully and truly yours,

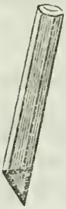
New Orleans, Feb. 22, 1847. P. B. Tyler.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Gentlemen,—From the great satisfaction which I have found in seeing and hearing of improvements in tools for mechanical operations, I have thought that a description of some of those which have appeared interesting and novel to me, might be acceptable to many of the readers of your valuable journal. A description of one or two of them will give you an idea of the class of improvements to which I refer.

Centre Punch.—It is customary, in moving the "centres" of a piece of iron intended to be turned, to drive a centre punch into the holes previously made; first, at an angle, in order to force the metal over to the side required, and then, to drive it in, perpendicularly, in order to give the hole the proper shape for the lathe centres. This is frequently repeated, until the hole is mutilated, or driven so deep as to be objectionable, and is absolutely *barbarous* on a nice piece of work. There are other modes of moving the centres of accurate work, such as the scraper and centreing drill, but this is the mode generally adopted on account of convenience, and for that reason has done injury to much fine machinery.

The new plan adopted for this purpose, which I saw in a small shop in Massachusetts, appears to me to be equally convenient with the ordinary centre-punch, while it is quite as perfect and unobjectionable as any of the more tedious modes. This tool is formed by making the conical point of a centre-punch on an angle with its shaft. It will be readily seen that by using this punch, the hole will be more easily moved laterally, that its uniform conical shape will be preserved perpendicular, and that the distance of moving it may be accurately managed by the blow of the hammer upon the punch.



Mode of Skimming Ladles for Pouring Cast Iron.—I saw, in a foundry in Connecticut, a mode of skimming small ladles for pouring cast iron, which was found to be very useful, and as I have not seen it in any other place, I presume it is new. It consisted in riveting a small bar of iron across the top of the ladle, just back of the mouth, and covering it with clay, the same as the bottom of the ladle, to prevent its cooling the melted iron. The bar should extend far enough below the top of the ladle to commence skimming from the first, and near enough to the mouth to continue until all is poured. I saw some ten or fifteen persons pouring with these ladles, while not one was required to skim, and I was told that no objection was found to it in any respect.

Respectfully yours,

New Orleans, Feb. 22, 1857. PHILOS B. TYLER.

On the Corrosion of Metals. A Paper by R. ADIE *of Liverpool, read at the Institution of Civil Engineers.*

This communication is intended to give an experimental proof of the fact, that water saturated with common salt, preserves to a great extent, the surface of the oxidizable metals from corrosion by the joint action of air and water. From some trials upon metals placed beside water in closed glass tubes, it was shown that water, or water containing a saline solution, does not act as a corroding agent, without the aid of the oxygen of our atmosphere. The details of some experiments, made to ascertain the quantity of oxygen dissolved by water under different circumstances, showed that brine and some other saline solutions contain much less dissolved oxygen than sea or ordinary water, which was the fact that induced the trial of salt water as a preserver of iron. The object of the last set of experiments was to determine by trial, the rates of corrosion of metals in fresh water, sea water, and brine; the results of these show that sea water corrodes the quickest, fresh water less rapidly, and brine very much slower than either.

On the rate of action of brine, sea and fresh water in corroding.

These experiments were made with weighed pieces of metal immersed in the three solutions under examination. Those which are compared together, were tried in every respect under similar circumstances, as to weight and surface of metal; size and form of vessel; quantity of water employed; light and temperature.

The experiments on zinc were made with that metal in connexion with a piece of copper, so as to form a galvanic couple; for zinc, when unconnected with a less oxidizable metal, is soon covered with a crust of oxide, so that pieces, after a month's immersion in water, are found to be slightly heavier than at the beginning of the experiment. This is not the case when a piece of silver or copper is in metallic connexion with zinc; for then the white oxide of the metal is gradually precipitated to the bottom of the containing vessel.

A plate of zinc, 1 superficial inch in area, immersed for 60 days in sea water, -	lost 1·6 grains.
A similar experiment in fresh water	" 1·15
A plate of zinc, 7 superficial inches in area, immersed for 96 days in fresh water,	" 4·9
A similar experiment in brine, or the saturated solution of common salt, tested as above for dissolved air, - -	" 1·4
Wrought iron wire :—	
Twenty pieces of iron, weighing 374 grains, immersed for 80 days in fresh water,	lost 1·9 grains.
A similar experiment in sea water -	" 2·6
A similar experiment in brine -	" 0·1
Cast iron :—	
Three rods of cast iron, weighing 787 grains, immersed for 62 days in fresh water, -	lost 1·6 grains.
A similar experiment in sea water -	" 2·0
A similar experiment in brine -	" 0·4

On comparing together the loss of weight of metal in the fresh water, sea water, and brine, it will be observed, that in sea water the corrosion is about one-third more than in fresh water; while in brine, the loss of weight is about one-fourth part of the loss in fresh water, and one-fifth part of that experienced in sea water; showing that brine possesses considerable power for preserving metals from corrosion. The carbonates of potash and soda are still more effectual in arresting oxidation; for in saturated solutions of these salts, iron wire remained immersed for 60 days without any amount of corrosion being detected. The surface of the plate of zinc, when taken from the brine, was the same as at the commencement of the experiment, excepting in three spots, where there was deep corrosion. The principal of these being around the point, where the copper wire connected the plate with the negative element. The difference shown between fresh water and sea water, in their power of oxidizing metals, is in the reverse order of the quantities of oxygen dissolved by them, as given in the preceding experiments; where the sea water is to the fresh as 78 to 85. The principle on which the preserving power of alcohol is attempted to be explained may, in like manner, be here applied to pure water. Although the experiments on the corrosion of iron were continued for eighty days, the difference between the action of common water and brine may be made apparent in one day. In the fresh water, the hydrated peroxide of iron is seen forming; while, in the brine, only a slight tinge of a greenish infusion can be detected, a sure indication of the scarcity of oxygen.

The experiments given to determine the respective rates of corrosion in fresh and sea water, are only correct for pieces of metal wholly immersed in them. Where the surfaces are subject to be wet and dry, the corrosive effect of sea water will greatly increase; on the same principle that iron once coated with rust, decays much faster after the rust has provided a lodgment for moisture. Take for example a bar of iron in a field, and a similar piece on the deck of a ship. On the first, the dew of night deposits water, which corrodes until the return of the sun dries it all off. On the second, on the deck, it deposits spray, which acts like the dew, until the sun dries it off; but when dried, there is left a thin deposit of salt, with a powerful affinity for moisture, which on the return of evening will attract moisture from the atmosphere, long before the dew wets the metal in the field. Thus it is that a coating of salt or rust, keeps metals much longer in a wet state, than if their surfaces were clean.

Remarks.—The experiments which showed that brine [by which term, he supposed, a saturated solution of common salt in water was meant] should be found to be less corrosive of iron than sea water, were consistent with the circumstance, that less air was contained in water which was saturated with any solid substance, than was contained in water only slightly impregnated with such substance, and there was no doubt, but that the atmospheric air performed a principal part in the oxidation of iron, which was exposed to the weather. Air containing water in solution, corroded iron rapidly; and water containing air in solution, did the same; and alternate exposure of iron to water and to air, corroded it still more rapidly: particularly when by the warmth of the sun, and the blowing of the wind, the film of water which was left on the surface of the wetted iron was evaporated, or dried away from that surface, before a fresh wetting occurred. Perfectly dry air was very slightly, if at all, corrosive of iron, and water completely freed from air by boiling, was not actively corrosive in the manner that air and water were. Respecting salt, there was nothing corrosive of iron in its own nature; it contained no oxygen, but although it was a great cause of corrosion of iron, the corroded iron was found to be an oxide, not a muriate of iron. The salt when dissolved in water, greatly increased the corroding effect upon iron which was immersed in the salt water, and still more if the iron was frequently wetted, or washed with salt water,and dried by the sun and the wind, in the intervals between successive wettings. The concurrent effect of air, water, and salt, was extremely corrosive of iron. It was well known, that dry salt was not at all corrosive of iron, for, in stoves for drying salt, the flues were frequently made of iron plates, and the salt in lumps being laid directly upon the iron, did not corrode it at all, the iron being always kept hot and dry; in the same stoves, if they were not used, and allowed to cool, the salt absorbed humidity from the air, and became very corrosive of the iron work. Iron salt-pans, for boiling brine, did not become oxidated as rapidly as might be expected: indeed, they were scarcely affected at the parts of the upright sides of the interior surface of the pans, which were always beneath the surface of the hot brine and were not exposed to the action of fire. The manner in which salt operated, to increase the oxidation of iron, was probably by an electro-chemical action, the chief part of the oxygen which the iron absorbed, being derived from the atmospheric air, the other part from the water, and none from the salt. In heaps of old iron exposed to water, it might be observed to lodge in the hollows, and to occasion rapid rusting of the iron, attended by a smell of hydrogen, and a thin pellicle floating on the surface of the water, showing dingy prismatic colors. The paper which had been read, mentioned absorption of oxygen from the air by water; it was generally understood, that, when water absorbed air from the atmosphere, the nitrogen of the air, as well as the oxygen, were both absorbed together by the water, in their accustomed proportions, as they existed in the atmosphere, so as to be an absorption of atmospheric air by the water.

Mr. Lowe said, the paper led to the consideration of the change which was induced in cast iron, by continued immersion in various fluids. This had been frequently discussed at the Institution, and it would be desirable if Mr. Adie would continue his experiments, with a view to elucidating that question, as the conversion of cast-iron into carburet of iron, or graphite, appeared, under certain circumstances, to be so rapid, as to have rendered necessary the substitution of other and more expensive metals. In breweries, for instance, the change had been produced so very speedily, wherever the acid wash came in contact with metal, that copper gratings had been of necessity substituted for cast iron.

Sir John Rennie, President, stated, that the earliest example in his recollection of the change produced by sea water in cast iron, was in some iron guns which were fished up in 1822, off Holyhead. They were supposed to have belonged to a pirate vessel which was destroyed there about 100 years previously. When found they were quite soft, but after exposure to the air for a time, they became so hard, that they were used to fire salutes, when George the IVth passed through Holyhead, on his way to Dublin, and it was remarked that the report from them was louder than from any other iron guns of a similar size.

Civ. Eng. & Arch. Jour.

Description of the Iron Dock-gates, constructed by Messrs. Rennie, for the Russian Government, and erected at Sevastopol, on the Black Sea. By Mr. Shears, Assoc. Inst.

Sevastopol is peculiarly situated, amidst rocky ground rising so abruptly from the shore that there was not space for the buildings necessary for a dockyard. On account of the depth of water close in shore, and other natural advantages, the Emperor determined to make it the site of an extensive establishment; and as there is not any rise of tide in the Black Sea, and the construction of coffer-dams would have been very expensive and difficult in such a rocky position, it was decided to build three locks, each having a rise of 10 feet; and at this level of thirty feet above the sea to place a main dock with lateral docks, into which vessels of war could be introduced, and the gates being closed, the water could be discharged by subterranean conduits to the sea, and the vessel being left dry, could be examined and repaired even beneath the keel. A stream was conducted from a distance of twelve miles to supply the locks, and to keep the dock full. This, however, has been found insufficient, and a pumping engine has since been erected by Messrs. Maudslay and Field for assisting. The original intention was, to have made the gates for the docks of timber; but on account of the ravages of a worm, which it appears does not, as in the case of the Teredo Navalis, or the Terebranes, confine itself to the salt water, it was resolved to make them with cast iron frames covered with wrought iron plates. There are nine pair of gates, whose openings vary from 64 ft. in width and 34 ft. 4 in. in height for ships of 1200 tons, to 45 ft. 7 in. in width and 21 ft. in height for frigates. The manipulation of such masses of metal as composed these gates demanded peculiar machines. Accordingly, Messrs. Rennie fitted up a building expressly with machines constructed by Mr. Whitworth; by which all the bearing surfaces could be planed, and the holes bored in the ribs and all the other parts, whether their surfaces were curved or plane. The planing was effected by tools which traveled over the surfaces backwards and forwards, cutting each way; the piece of metal being either held in blocks, if the surface was plane, or turned on centres, if the surface was curved. The drilling was performed by machines so fixed that the pieces could be brought beneath or against the drills in the required direction, and guided so as to insure perfect uniformity and accordance between them. Traveling cranes were so arranged as to take the largest pieces from the wharf, and place them in the varions machines, by the agency of a very few men, notwithstanding their formidable dimensions;—the heelposts, in some cases, being upwards of 34 feet long. Each endless screw, for giving progressive motion to the cutting tools, was 45 feet long. Some idea may be formed of the manual labor avoided by the machines, when it is stated that the surface planed or turned in the nine pairs of gates, equals 717,464 square inches, and in some cases, a thickness of three-quarters of an inch was cut off. The surface in the drilled bolt-holes equals 120,000 square inches. The paper gave all the details of the construction of the gates and the machinery for making them,—and was illustrated by a series of detailed drawings. A discussion followed; chiefly on the peculiarity of the site selected for the docks,—and the supposed ravages of the worm in fresh water, as it was of unusual occurrence. It seemed to be the opinion that temperature of climate influenced the ravages of these insects.—*Transac. Inst. Civ. Eng.* Athenæum.

Observations on the Phenomena of Terrestrial Refraction.

I have been induced to make the following remarks, from the perusal of a paper on this subject, by Dr. W. Kelly, R. N., and which appeared in the August number of the *Nautical Magazine* for the last year.

The result of the Doctor's observations seems to me to accord so well with the established theory of refraction, depending upon the transmission of the visual rays, through mediums of varying densities, that it may perhaps be interesting to some of your readers to trace the connexion which I have attempted to establish in this paper.

When the superincumbent air is in a state of comparative equilibrium, and the vapor contained in it is impartially distributed, I apprehend that no perceptible distortion of image will take place. The air may be denser or more rarefied according to its temperature, and the moisture may be in excess or defect of its mean quantity, so as to increase or diminish the refraction; but so long as these conditions were equally diffused over that portion under examination, there would be no apparent distortion, and, indeed, the observer, without the aid of an instrument, could scarcely detect the presence of any unusual cause of variation. Immediately, however, this state of equilibrium, or equal diffusion of the refracting medium, is destroyed, the visual rays, instead of describing nearly uniform curves, will be deflected variously, according to the condition of the mediums through which they are transmitted.

By reason of the highly elastic nature of the atmosphere, no very partial effects from varying causes, could, I imagine, be maintained: and therefore, it seems to me, that the principal causes of unusual refraction arise from the changes produced in the *aqueous* portion of the atmosphere, by alterations of temperature; and these changes will be more or less remarkable, according to the quantity of moisture present. Where the air is saturated with moisture, it will require but a small change of temperature to produce a perceptible effect on the refraction, compared with what would be required when the air was dry.

Let us now see what would be the effect assigned by theory to that condition, in which the surface water was *colder* than the incumbent air. The moisture in the latter would be condensed, and from its increased gravity would descend and augment the refracting power of the medium, so that rays transmitted through it, from any distant object, would reach the eye under a greater angle of elevation. The moisture so affected, frequently rests upon the land or water in a strongly defined stratum; and when its height is less than the object seen through it, distortion will be very evident, and sometimes very curious. In the North Sea, during this state of the atmosphere, I observed the luff of the jib of a fishing smack, about two miles distant, to be bent and assume the shape of a jib-topsail.

A distant ship, seen at the same time, was affected in the following manner:—The hull appeared of its proper form and size, perhaps somewhat larger, and the courses were not so much contracted in height as the top-sails, whilst the top-gallant sails retained their usual appearance. Now, that part of the stratum of vapor which was near the surface of the sea, might, I conceive, be very nearly of the same density; and hence, rays proceeding from objects immersed in this medium, being affected nearly in the same degree, would bring to the eye an image but very little distorted from its real proportions, although the *direction* would be erroneous. The courses would be influenced much in the same manner, but with less uniformity; for, being in the higher and more rarefied part of the medium, they would be less refracted in their upper parts than in their lower, and a slight contraction would therefore be evident; but, in the case of the top-sails, whose upper portions were *above* the influence of the extraordinary refraction, the rays proceeding therefrom would reach the eye under the usual angle of elevation, whilst the lower parts, being *within* the medium of extraordinary refraction, would be elevated above their true position, and hence give to these sails a very sensibly *contracted* appearance. The top-gallant sails, being entirely above the defined stratum of vapor, would appear of their ordinary shape.

These phenomena were, in my opinion, concomitants of that condition of the air and water, in which the temperature of the latter was lower than that of the former.

When the surface water is *warmer* than the incumbent air, a contrary effect will generally be produced, and more particularly when the air is unusually dry. Under these circumstances, there is no tendency to *stagnation*, as in the former case, where the moisture descends and hangs on the surface in fogs or dense vapors, thereby increasing the refractive power; but the evaporation from the water being regulated by the demand in the air, is continually carried upward *(not accumulated)* until it meets with an arresting atmosphere, and is condensed in vapor and cloud. Calms are, therefore, more particularly favorable to the production of the mirage with elevated horizon; for a breeze, by disturbing and dispersing the stagnated medium, will, in most cases, destroy the phenomenon.

A variety of circumstances may occur in these partial affections to modify the results of general principles, and it shows us how very difficult it is, even with the help of a dip-sector, to obtain a true correction for refraction; for where these mirages are of frequent occurrence, as in the Polar Seas, and Gulf of St. Lawrence, owing to the presence of currents of unequal temperature, how often may the opposite portions of the horizon be under the influence of unequal intensities. From these variations of density in the different parts of the superincumbent air, it is almost impossible that the amount of terrestrial refraction will be the same at different times, for different places. The visual rays, instead of describing regular curves, may be deflected in a *zigzag* line; and this circumstance will sufficiently account for the wide difference in the values assigned by the several observers to the effects of terrestrial refraction.

For the same reason, the indications of the thermometer and hygrometer will be, in general, too partial to account for phenomena produced at a distance.

The occurrence of mirage during strong, or even fresh, winds, can be, I imagine, but seldom, particularly of that kind with elevated horizon; nevertheless, the atmosphere, by being charged with an unusual quantity of moisture over a wide space, might continue for some time to produce mirage of the latter description, even in the presence of a strong breeze; while those with the depressed horizon might more readily exist whenever the air was unusually dry.

As the temperature of the sea is not changed by solar influence nearly in the same degree as that of the air, this circumstance, considered by itself, would be most favorable for the formation of mirage with *elevated* horizon, when the latter had attained its maximum temperature, or at some time in the afternoon; whereas, that of the former kind would, from the same circumstances, occur more frequently in the morning. Again, as evaporation is usually more active during the heat of the day, it would operate against that *stagnation* which I have considered favorable to the production of mirage with an *elevated* horizon; but as the air became cooler, this activity would be checked, and a condensation of moisture near the surface of the sea, and increased refraction would probably take place. So that two circumstances combined would seem to point out the latter part of the solar day, as the time when this kind of mirage will be most frequent. The light winds, which often succeed to the fresher breezes of the day, may also have their influence.

While employed in the North Sea survey, I had frequent opportunities of observing the curious and important effects produced in the atmosphere by the various causes above mentioned. Our operations when out of sight of land, depended very much on the horizon and the subtending angle of the Tender's mast, which are both materially affected by the changes in the state of the atmosphere near the sea. I have known the latitude of the same position to differ 2½ miles by meridian observations on two consecutive days; and the longitude would necessarily share in the error of the latitude as well as in the originating cause. The use of the dip-sector, and the method of observing the altitude, north and south, should therefore be resorted to; for, although, (as I have before remarked,) even these might give erroneous results, they would materially serve to decide our judgment as to the value of these observations.

The subtending angles were, from the same causes, very materially and frequently affected, and the distances deduced therefrom incorrect. In the case of an elevated horizon, the lower part of the vessel being more refracted than the upper, the observed angle is therefore smaller, and the assigned distance proportionally greater, than the truth; and this error increases as the object is nearer to the horizon. Hence the propriety of great caution in using this mode of obtaining distances; and the preferable method of a base found by two objects, especially in establishing the several positions of the stationary vessel.

At present, I despair of seeing these fluctuating causes and effects brought under the subjection of any law that could enable us to assign its true amount, and to correct those observations which come under their influence.

G. A. Bedford, *Commander, R. N.*
Lond. Naut. Mag.

On Gun Cotton. By Professor Brande.

This communication related: 1st. The history of compounds produced by nitric acid with certain organic substances. 2nd. The preparation and properties of Schönbein's gun-cotton. 3rd. The practical uses of the invention.—1st. With respect to the philosophical history of the discovery. Between fifteen and sixteen years ago, Braconnot ascertained that starch, wood-shavings, saw-dust, linen and cotton fabrics, when treated with concentrated nitric acid, produced a sort of gelatinous substance, which coagulated into a white mass on the addition of water. Braconnot called this substance *xyloidine,* from its resemblance, in some respects, to ligneous matter. Xyloidine is, as Professor Brande demonstrated by experiment, highly inflammable. Two years after Braconnot's investigations, Pelouze published some inquiries into the nature and properties of xyloidine. He ascertained that starch, when converted into this substance, exchanged an atom of its constituent water for an atom of nitric acid. He also observed that it took fire at a temperature of about 360°. This facility of combustion, and the fact of its burning without leaving residue, induced Pelouze to cover paper and other textures with a film of xyloidine by plunging these substances into dilute nitric acid. When thus prepared, they resemble parchment in appearance, are very inflammable, and impervious to moisture. Pelouze suggested the use of paper treated in this manner for the purpose of artillery. Such was the state of science on this subject when, in the course of last year, Professor Schönbein examined the effect produced by a mixture of sulphuric and nitric acids on organic bodies. One purpose of his research was to ascertain the qualities of a form of matter which he calls *ozone.* On this subject we cannot digress further than by presenting the following equation, which will convey Schönbein's views to our chemical readers:—

$NO^5\ HO + SO^3\ HO = NO^4\ SO^2 + 2HO^2$. ($HO^2$, the symbol of the oxy-water of Thenard, being also that of Schönbein's ozone). It was in the course of these researches that Schönbein found that each of those singularly allied bodies, sugar, starch, gum, and woody fibre, assumed its own peculiar state when brought under the influence of the mixed acids; and that woody fibre in the form of tow, cotton-wool, &c., when plunged into a mixture of these acids, becomes a highly explosive compound. The substance thus prepared was exhibited, on Professor Schönbein's behalf, by Mr. Grove, on the 15th of September last, to the British Association, and (as Professor Brande pointedly observed) it was not till that time that the supposed claims of others to any share in this discovery were advanced.—Professor Brande proceeded, 2ndly, to describe the preparation and properties of the gun-cotton. Having been first cleansed and carded, cotton, according to Schönbein's process, is immersed for a short time in a mixture of two parts (by measure) of sulphuric with one of nitric acid. It is then taken out, well washed with water, and carefully dried. The cotton is then found to have acquired the following properties:—Though identical with common cotton (even under the microscope) in ordinary light, it appears dark when viewed through a magnifier in polarized light. It may be repeatedly moistened with water and dried without losing its acquired properties. It is an insulator of electricity, being powerfully *negatively electric.* It is singularly hygrometric. It catches fire at a temperature of about 360°, and burns with far greater rapidity than gunpowder; and yet the combustion of a train of this cotton can be stopped in its course by strong pressure—an important circumstance as bearing on its application. The products of its combustion are carbonic and nitric oxides, carbonic and oxalic acids, cyanogen, nitrogen, and steam.—3rdly, In respect to the uses of gun-cotton, Professor Brande remarked that it was more energetic than gunpower. From experiments made at the mills of Messrs Hall & Co., the patentees, it would appear that about one half ounce of gun-cotton carried a 68 lb. shot 255 feet from an 8-inch mortar; while 2 ounces of gunpowder carried a shot of the same weight, from the same gun, only 152 feet. The average of four fires from a tiger-rifle, No. 14 gauge, charged with from 60 to 80 grains of gunpowder, carried a ball through three *inch elm boards* packed closely together; while 30 grains of gun-cotton carried a ball, under the same circumstances, through *six such boards.* Adverting, in conclusion, to the alleged disadvantages and advantages of Schönbein's invention, Professor Brande remarked of the former that it was hardly just to ascribe them to what was so recently known, and, therefore, so imperfectly examined, as an article of commerce. The use of gun-cotton in fire-arms has been said to be attended with the following disadvantages:—That the effects are less regular than those of gunpowder.—That it is more dangerous, because inflaming at a lower temperature.—That it does not take fire when compressed in tubes.—That it burns slowly in all kinds of cartridges.—That guns and pistols must be altered to admit of its use.—That it is not adapted for the use of the army.—That the barrel of the gun is moistened by the water produced during combustion. The advantages, on the other hand, may be stated as follows:—Its extreme cleanliness, leaving no residue after combustion.—Its freedom from all bad smell.—The facility and safety of its preparation.—The possessing treble the force of gunpowder.—Its explosion producing no smoke and less noise than that of gunpowder.—Its filamentary nature admitting of its being used overhead in mining operations.—Its not being liable (as a granulated substance is) to the accidents of leakage.—Its occasioning very little recoil.—*Trans. Royal Inst.* Athenæum.

On Gunpowder. By PROF. FARADAY.

Prof. Faraday briefly noticed the known composition of gunpowder as consisting of—75 parts of nitre, 15 parts of charcoal, 10 parts of sulphur; which, converted into equivalents, give—1 of potassium, 1 of nitrogen, 6 of oxygen, 3·4 of carbon, 0 85 of sulphur, in a state of mechanical mixture. He then proceeded to advert, 1stly, to the *manner of the action of gunpowder.* Gunpowder was described as a solid body, in which a source of enormous power was locked up, capable of being brought into immediate operation whenever wanted: the action thus elicited being itself regulated by human skill with wonderful precision. The respective functions of the sulphur, nitre, and charcoal, in producing the effects of gunpowder, were experimentally shown. The enormous quantity of gas generated by the combustion of gunpowder, irrespective of heat, was exhibited. It was remarked that, on the ignition of gunpowder, though the sulphur begins the combustion, it is not itself burned by the oxygen of the nitre, but unites chiefly with the potassium of that salt to form sulphuret of potassium,—a substance which assists in giving to the flame of gunpowder an intense heat. 2ndly. The *amount of heat required for the inflammation of gunpowder* was next adverted to. If gunpowder and steel filings be dropped together through four or five inches of flame, the latter will burn, though the former will not. A flame from gas was made to play for several seconds on a heap of gunpowder, without lighting it; but, 3rdly, *when actually lighted, gunpowder evolves very great heat.* It is to the immense heat produced on the solid products of the combustion of gunpowder, that the certainty of its complete combustion is greatly owing. In this respect gunpowder differs characteristically from gun-cotton. The latter fires at a heat which would not affect the former; but produces, by its combustion, a degree and condition of heat much less communicable to other bodies. 4thly. The *effect of the heat generated, independent of the chemical change from the solid to the gaseous or vaporous state,* namely, that due to mere expansion or increased elasticity producing the effects of gunpowder, was adverted to. This was illustrated by the violence with which a mixture of one volume of oxygen with two of hydrogen gas bursts the vessel which contains it, solely in consequence of the heat elicited during their combination. This is manifest from the fact that the space occupied by the uncombined gases, is greater by one-half than that taken by the resulting steam. 5thly. Prof. Faraday laid great stress on the *effect of the granulation of gunpowder.* To this condition of gunpowder, presenting, as it does, a number of separated surfaces of size just sufficient to become surrounded with flame at the same instant of ignition, much of the disruptive or projectile effect of gupowder was ascribed. It was shown that, without that porosity which its division into grains imparts to a mass of gunpowder, the explosion of the whole could not be instant nor simultaneous. This was proved by bringing a piece of mill-cake successively into the condition of grain powder and of meal powder. The slow combustion of the solid meal powder fuse was compared with the quicker inflammation of the hollow rocket, and the instant inflammation of the charge of a gun. All these effects are related to the condition of the interior of the gunpowder in respect of its permeability by the flame of the first particles ignited. Then, as to its exterior condition, it was shown that the tardy burning of the miner's fuse is due to the granular state of the powder in its case being counteracted by the pressure of the strands of rope wrapped very tightly round it; while, on the other hand, in the cracker of the firework-maker, a similar train is instantly fired throughout, because it has a loose jacket all over it, and, in the burning of the common cracker, an alternation of these effects is produced. In conclusion, Prof. Faraday dwelt on the great importance of *time* in producing the effects of gunpowder. Contrasting the action of gunpowder with that of fulminating mercury and silver, or of those still more fearfully explosive compounds, the chlorides of nitrogen and of iodine, Prof. Faraday showed that, if the explosion of gunpowder were really instantaneous, it would be useless for all its present applications. As it is, however, whenever gunpowder is fired in the chamber of a gun, it does not arrive at the full intensity of its action until the space it occupies has been enlarged by that through which the ball has been propelled during the first moment of ignition. Its expansive force is thus brought down and kept below that which the breach of the gun can bear, whilst an accumulating, safe, and efficient momentum is communicated to the ball, producing the precise effects of gunnery. This manageable action was contrasted with the effect of a morsel of iodide of nitrogen put on a plate, and exploded by being touched by the extremity of a long stick. The parts immediately in contact with the iodide were shattered,—*i. e.*, the end of the stick was shivered, and the spot in the plate covered by that substance, was drilled as if a bullet were fired through it, yet no tendency to lift the stick was felt by the hand,—whereas the comparatively gradual action of gunpowder lifts and projects those weaker substances, wadding and shot, which give way before it. Ibid.

Recent Discoveries and Improvements in the Arts in Europe.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Extracts from a letter of M. JOBARD, *Director of the Belgian Musee de l'Industrie to* DR. QUESNEVILLE, *Editor of the Revue Scientifique et Industrielle.*

After briefly describing the cotton powder of Prof. Schönbein, he proceeds:—

Malleable Glass.—"The same chemist has discovered what may, to a certain extent, be called *malleable glass.* He renders the pulp of common paper transparent, by causing it to undergo a certain transformation, which he calls *catalytic*, for want of an intelligible term. With this paper, made water-proof, he manufactures perfectly transparent window-panes, vases, and bottles, which may be let fall without breaking."

Important Discoveries made and lost.

Grape Sugar.—"As there are persons who having made a fortune cannot keep it, so there are experimenters who have made important discoveries and have lost them. For instance,—Prof. Meynier, of Marseilles, one day crystalized perfectly *glucose*, (grape sugar,) and since that time he has sought in vain the conditions under which the crystals were produced."

Metallic Cement.—"The same thing happened to the engineer Brey, of Milan, who once hit upon a metallic cement—of which he made a tube, which presents all the characters of cast iron—without being able, since that time, to hit again upon the same proportions. M. Brey believes that he recollects that there entered into the composition, ammonia, sulphur, sifted iron-filings, and another ingredient, which, as well as the proper proportions of the materials, he forgets; but there is his tube, which, under the file and cold chisel, behaves exactly like cast iron."

Apparatus for Measuring the Force of Galvanic Magnets.—"The Italians are, as is known, skilful electricians, the scientific world knows Professor Magrini, of Breyra, who is now preparing a beautiful series of experiments upon electro-magnetism. We ask his pardon for describing the curious apparatus for measuring, experimentally, the force of galvanic magnets, which we saw upon entering his laboratory. It is very simple when it is once invented. To the upper cross-piece of a wooden frame, M. Magrini hangs a dial dynamometer, to which he attaches a horse-shoe magnet, the armature of which terminates in a rack which slides in a beam below. This armature is raised or lowered at will, by means of a pinion or handle. The two wires of the magnet dip into cups of mercury affixed to the sides of the frame, and in communication with the wires of the battery. It is easy to conceive that, being thus able to approach the armature of the magnet more or less, he is able to maintain it at the proper distances to measure all the zones of the attraction of the magnet. Thus he will, without doubt, find the law of decrease of the magnetic influence, upon which philosophers are far from agreeing,—and he will examine the singular assertion of M. Magnee, foreman of the manufactory of arms, at Liege, who asserts that the extent of the influence of permanent magnets is ten times that of temporary magnets exerting the same force at contact. M. Magrini protests against the law laid down by MM. Jacobi and Lenz, that 'when there is no limit either to the mass of the bar, or to the length of the wire wrapped around it, we may, with a current of any force, produce an electro-magnet of any desired power.' M. Magrini has found that, for each element of a Grove battery, a wire of a diameter of $\frac{1}{25}$th inch cannot exceed the length of 200 metres, (217½ yards,) without loss.* M. Cristiforis, Secretary of the Institute of Milan, asserts that the enveloping wires should not be laid along side of each other, but that they should cross each other at a certain angle, to get the greatest possible coercive power."

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* This assertion is imperfect; the size of the element should have been given.

Stone Railways.—"But we cannot pass unnoticed the proposition which he is about to make to the Milan Institute, on the subject of a system of stone railways, very practicable in that country with the elastic and tough lava which abounds there. M. Cristiforis proposes to plant solidly in the ground two lines of these stones, as rails, to cut in them two longitudinal grooves, forming the cap of the rail, and to cover this cap with a band of felt, itself enveloped with a band of sheet iron let in the two lateral grooves."

"M. Cristiforis thinks that this rail will not cost more than one and a half francs per metre, (27·5 cents per yard.) which will allow Lombardy to be covered with small roads, worked by horses, and sufficient for a country where iron, wood, and charcoal are rare, and where they do not much care to move quickly,—judging by the slowness with which you go from Milan to Venice."

Magnetical Clock.—"The mechanician of the University of Paria has just finished a meteorological clock, which shews, at the same time, the temperature and pressure of the air, the direction and intensity of the wind, the magnetic variations, and every thing which it is possible to measure and record."

Powerful Electrical Machine—"M. Mousson, Professor, at Zurich, showed us an electrical machine of the ordinary kind, but singularly improved, which, with a single turn, gives a spark of from nine inches to one foot. The whole secret of this improvement consists in the substitution, in place of the two narrow cushions of leather, of two plates of tin, which at least quadruple the rubbing surfaces. Of course the tin plate in contact with the glass rests upon an elastic cushion, fitted in the thickness of the plate. This machine is not in the least influenced by the variations of moisture in the air, which so often destroy the effect of others. The two electricities are here disengaged in such abundance, and the sparks are so long, that it is easy to distinguish, by the eye, the direction of the fluid, and the points from which, and to which, they go. We should add, that the plate of a good machine ought to be of Bohemian glass, which is made with potash. The plates made with the salts of soda, like the French, are worthless for this purpose.

"We recommend them to philosophical instrument makers who desire to have something better than the miserable spark, at most capable of killing a mouse, while these machines, of which we speak, might be advantageously substituted for the guillotine, and satisfy what we call *the justice of man*, without spilling a drop of blood."

Operation of the Prussian Patent Laws.—"Zurich has a technological school admirably conducted by Professor Deschwanden. We cannot speak of an important discovery which he has made, and which he cannot publish without losing the fruit of his labors: for artistic property is not even protected by patents in Switzerland; which patents are too costly in England, too short in Germany, too easily evaded in Belgium, and too easily attacked in France.

"To give you an idea of the way in which they protect inventions in Prussia, it is enough to state that they will give you a patent for six years for an atmospheric railroad, on condition that the patentee has his road finished in six months from the delivery of his letters patent. They thus apply to railroads the rule evidently intended for blacking and phosphorus matches.*

"In Belgium they give you two years, but on condition that your railroad shall be put into *regular* and *continuous* operation, *so as to be useful to the arts and to consumers, &c., &c.,* on pain of forfeiture and loss of your money.

"We are not joking, but copying from authentic documents. This can only be compared to the literary protection which we enjoy under paternal governments. For example, I saw at Genoa a conscientious historian, who had spent twenty years in composing a magnificent work, the *Belleze di' Genova*, illustrated by magnificent engravings, and of course, pretty costly: a rascal such as we meet every where, got hold of the proofs, and before M. Baachera had finished his analytical tables, he had sold his first edition; *Sic vos non vobis.* The author is ruined, the robber enriched. At Brussels, this skilful pirate would certainly have obtained a decoration.

"Apropos to Brussels, I announce to you that it has an inventor who will soon pass above the heads of all the others; if what we have touched is real, if what we have heard is true, Dr. Vanbeeck has made a great step in æronautics—finding a fulcrum in the atmospheric ocean. You know that heretofore you could not rise or descend in a balloon except by discharging ballast or gas, by which the ærial journey was necessarily abridged. Dr. Vanbeeck has found a way to rise, descend, stop, and rise again a thousand times, without losing a particle of ballast or gas; he does not propose to sail balloons against the wind, but he desires to seek a suitable current, and suffers himself to be carried along with it, which is very prudent, as well in a physical as a moral sense.

"We believe that this inventor, to whom the celebrated Margot gives his assistance, and *gutta percha* its impenetrability, has a better chance than his predecesssors. *Videbimus infra.*"

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* Our patent laws contain an admirable provision of the same general applicability, by which, patentees are required, under a penalty "to stamp, or engrave, on each article vended or offered for sale, the date of the patent," which becomes difficult, to say the least of it, in case of needles, pins, nails, gun cotton, burning fluids, vegetable pills, &c.

JOURNAL

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State of Pennsylvania,

AND

AMERICAN REPERTORY.

MAY, 1847.

CIVIL ENGINEERING.

Report of the Commissioners appointed by the Legislature of the State of New York, by the Act of May 11, 1846, *to locate certain portions of the New York and Erie Railroad, made to the Legislature, January* 14, 1847.

(Continued from page 230.)

Sullivan County or Interior Route.

It has been shown that the train will proceed from Deposit to the mouth of Callicoon Creek with a load due to a level, or a grade descending 15 feet per mile; the load being restricted by the return load to 358 tons freight. The extra power required to carry this load up a grade of 45 feet per mile is 2·34, or $2\frac{1}{3}$ engines of equal power. We have then $40 \times 2 \times 2{\cdot}34 \times 1{\cdot}5 = 280{\cdot}8$ cents per mile run with a load of 358 tons, $280{\cdot}8 \div 358 = 0{\cdot}78$ cents per ton per mile.

The distance on which this grade rules, as before remarked, between the mouth of the Callicoon and Wurtsboro, is 52·58 miles; but, as it is to be compared with the Delaware river line from the mouth of the Callicoon to Port Jervis, it should be taken for extra power for no greater distance than that between the two latter points, or 48·97 miles. The extra power will therefore be taken for this distance.

This route is 2·61 miles longer than the Delaware river route. The extra length will be estimated the same as that for extra length of the Nineveh route, viz: at one cent per ton per mile on freight each way; or, charging wholly on freight moving eastward, 1⅓ cents per ton per mile.

Summary of extra cost of transportation on Sullivan county route, charging the whole cost on freight moving east:—

48·97 miles, at 0·78 cts. per ton per mile,	38·19 cts. per ton.
2·61 " extra length, at 1⅓ cts. per ton per mile,	3·48 " "
Total extra cost per ton over the Delaware river route,	41·67 cents.
Extra cost on Nineveh route, as before shown,	22·57 "
Total extra cost on the interior routes,	64·24 "

Having determined the extra cost of transportation per ton, caused by the heavy grades and extra lengths, it becomes necessary to ascertain what will be the total tonnage annually transported over the road. The calculations are all based on charging the whole expense of extra power on freight moving eastward; that moving westward being provided for by the method adopted to determine the question. It is therefore the tonnage moving eastward that we want to ascertain the amount of.

The officers of the New York and Erie Railroad Company, in presenting their views of this question to the Commissioners, assumed that 500,000 tons per annum would be transported eastward over the railroad. This position was not controverted by any person interested in the Northern or other routes.

It is not possible to arrive at accuracy on this point; and the Commissioners are not willing to say the road will not eventually reach this estimate: but this would be a very large business for a general trade, and much beyond the capacity of a single track road. The question to be determined is, what amount of trade will pass over the section between the Shawangunk ridge and Port Crane, in Broome county.

An estimate of this kind should look to some future period, when the business of the road might reach, not its full capacity, but such as would form an average with the past and the future.

The Baltimore and Ohio railroad, as now, and for several years past, has been worked about 180 miles. For the year ending September 30th, 1846, there was transported on it, to and from the different points, 193,916 tons, (including the trade in both directions,) equivalent to about 84,000 tons carried over the whole road.

The New York and Erie railroad, when completed, will extend about 260 miles beyond Port Crane, in Broome county. Now, if we suppose 3 tons carried to Baltimore, to 1 ton in the opposite direction, there must have been about 145,000 tons moved towards Baltimore. This proportion applied to the New York and Erie railroad, for equal distances, would show about 210,000 tons arriving at the western end of the routes under consideration. Whether the two roads should be regarded as presenting a fair parallel for amount of trade, is, however, a question which may admit of a difference of opinion.

The tonnage on the western railroad, from Albany to Worcester, 156 miles, for the year 1845, was equal to 93,392 tons carried over the whole road. This includes freight in both directions. On this road the freights in opposite directions are more nearly equal than is usual. Judging from the amount received for freight, it appears to be not far from two to one. This would show a result about 13 per cent. greater for the tonnage towards tide water, comparing the distances, than the Baltimore and Ohio railroad. It is to be considered, however, that a considerable portion of this tonnage is from place to place, and forms no part of the through tonnage.

The route traversed by the New York and Erie railroad is understood to be in general a grazing district, that furnishes freight of greater value but of less tonnage than a grain growing district.

The Commissioners have been much embarrassed in forming a satisfactory estimate on the amount of tonnage. It does not appear practicable, from any data in their possession, to reach any definite accuracy, and their estimate must be considered as in a great measure conjectural.

The amount assumed by the engineer of the Company is regarded as too high to form the basis of comparison between the several routes. The Commissioners have assumed 200,000 tons as the annual amount of freight that may be expected to move eastward over that portion of the road embraced in this question of location; this, they think as high an estimate as they are warranted to make for this comparison.

It has been shown the cost of transportation will be 64·24 cents per ton (computed wholly on freight moving eastward) greater on the interior routes than on the river routes.

This rate on 200,000 tons per annum, is 200,000 tons at 64·24 cents per ton, = $128,480.

The passenger trade will feel the unfavorable influence of the heavy grades, and will require extra power; or, the train must proceed over them at reduced velocity.

The excess of curvature on the Nineveh, and the Sullivan, or interior routes, over that on the river routes, is 3903 degrees, or equal to 10·84 (nearly 11) entire circles. The excess of curvature is mostly on radii of less than 1000 feet, and frequently occurs on the heavy grades. It will no doubt increase the expense of power. The Commissioners are not aware of any definite data, by which this question can be reduced to computation. Heavy curving on railroads is regarded to be the next unfavorable thing to heavy grades, and great expenses are often incurred to reduce the curves to large radii, or dispense with them altogether.

Not only is more power required to move the train, but the displacement and wear of rails, and the wear of cars and engines is much greater on sharp curves than on a straight line. On the Nineveh and Susquehanna lines, an allowance of 10 feet per mile, or 15 per cent., was made for the curve lines: whether this is sufficient for the extra power is doubtful. On the Sullivan county lines no such allowance was made. If it had been, it would have increased the maximum grade in the same proportion. If the same rule be applied to this, it will raise the total cost of extra power to nearly 70 cents per ton.

Regarding the extra wear of rails, cars, and engines, this great excess of curvature, though not susceptible of a definite reduction, must be considered as a very serious objection to the interior lines, when viewed only in connexion with the freight business. Its influence on the passenger trade, exposing the cars to leave the track, causing greater wear to the road and machinery, and restricting the speed of traveling, is still more serious.

The interior routes will be more obstructed by heavy snows (especially that in Sullivan county) than the river routes, which will increase the expense of running, and cause delays that will be prejudicial to the business of the road during the winter season.

Heavy grades cause extra wear on the rails, cars, and engines, from the more frequent and severe application of the friction brake, to control the latter in their descent. The cars on the heavy grades would not stand still without being secured, and consequently, any accident by which a car should get loose, would allow it to move off with great velocity, putting at hazard its own safety, and that of others that might be in its way. Any circumstance that should disable an engine in ascending a heavy grade, such as the slipping of the wheels, or the machinery suddenly getting out of order, would put the whole train at hazard.

On a long line, where the passenger traffic will be important, the excess of heavy grades and curvature on the interior routes will have a material influence on the economy and usefulness of the road.

The several points of disadvantage that appertain to the interior routes, as above considered, namely—the influence of the great excess of curvature on the freight traffic, together with that of the heavy grades on the passenger traffic—the greater exposure to heavy and drifting snows—extra wear of rails, cars, and engines, on the excess of heavy grades and curvature—with the greater hazard of accident and consequent damage, are of a character that does not admit of any definite computation. They are, however, of such importance, that heavy expense, where a change of route is practicable, may well be incurred to avoid them. That they materially impair the value of a railroad, is beyond question. After careful consideration, the Commissioners have come to the conclusion that, collectively, they will not be less than half the amount before stated, as the excess on the freight traffic caused by the excess of heavy grades.

The total amount of excess chargeable, as before presented, to the interior routes, is:—

On freight arising from heavy grades,	$128,480
On items above enumerated, collectively assumed at 50 per cent. of the above,	64,240
	$192,720

From this, there must be deducted :—

First, The extra cost of constructing and maintaining the Southern line.

Second, The annual tax imposed by the state of Pennsylvania.

In relation to the first, the estimates of the engineers show the extra cost to be $519,821. To this must be added the interest that will accrue on the expenditure until the road is in operation, and receiving income from its business. This will, of course, depend on the vigor with which the work is prosecuted, and the facility with which its traffic may be advantageously commenced. It is supposed ten per cent. on the whole sum would provide for all the accruing interest, making the capital invested for this item $571,803. The river routes, more particularly that along the Delaware, from the heavy bridges that must be maintained, and from the exposure of the work to the floods of this river, will be more expensive to keep in repair than the interior routes. This item is estimated at $15,000 per annum.

The second item, the tax imposed by the State of Pennsylvania, is chargeable when the whole road is completed to Dunkirk, or connected with some road leading to Lake Erie.

This annual bonus will not, therefore, be chargeable until the road is in full operation.

The annual charge will be as follows:—

Interest on $571,803, at 6 per cent.,	$34,308
Annual repairs—excess, - -	15,000
Bonus to Pennsylvania, - -	10,000
	$59,308

Summary of excess:—

On the interior routes, - -	$192,720
On the river " - -	59,308
	$133,412

Showing that the annual expenses on the interior routes will be $133,412 greater than those on the river routes. This result has been reached, after carefully considering and yielding every advantage to the interior routes which can be regarded as belonging to them. The mode of working on which the calculation is based, is the most favorable to them, involving the most careful attention to the economy of motive power; and the Commissioners feel constrained to say, that they have serious doubts whether a more expensive arrangement in relation to motive power, would not, on account of greater simplicity, be found more expedient in practice.

Herewith are submitted a map and profile, marked A, of the Nineveh and Susquehanna lines; a map and profile, marked B, of the Sullivan county and Delaware river line; a profile, marked C, of the several routes from Binghampton to the Shawangunk summit; and a profile, marked D, of the whole line of the New York and Erie railroad, from Piermont to Dunkirk. These have all been prepared under the directions of the Commissioners, and from surveys, also under their directions, except the general profile, which is from such surveys only on those portions that have come under the examinations of the Commissioners. From these maps and profiles, a good idea of the general features of the several routes may be obtained.

Tabular statements of the results of the surveys by Henry Tracy and James O. Morse, Esqrs., the engineers employed by the Commissioners, are also herewith submitted.

The Commissioners are required to take into consideration "the terms, conditions," &c., of the Act of Pennsylvania, authorizing the New York and Erie Railroad Company to construct a portion of their road in that State.

There are several conditions in the Act of the Legislature of Pennsylvania that are peculiar, and require the notice of the Commissioners.

First. The railroad, if constructed along the Delaware river, is required to "be so constructed as not to obstruct the rafting navigation, nor contract the natural flow (and expansion) of the said Delaware river, (at high floods,) nor injure the works," &c., of the Delaware and Hudson Canal Company; and in relation to the point of crossing the Delaware river. Similar provisions are contained in the Act of this State which constituted this commission.

On all these points the engineer employed by the Commissioners was instructed to conduct his surveys, and make his estimates with a view to a full compliance with these provisions.

Second. The 3d section of the Act of Pennsylvania requires certain laws to be passed by the Legislature of this State; it also requires from the New York and Erie Railroad Company, conditions in relation to the conduct of their business, which have been considered matters for said Company to look to, before they could legally locate their road in that State; but not requiring the attention of this commission.

Third. The 5th section of said Act requires that after the said railroad is completed to Dunkirk, or connects at its western termination with any improvement extending to Lake Erie, said Company shall pay to the State of Pennsylvania ten thousand dollars per annum. This is presumed to be the main condition to which the attention of the Commissioners was called, and they have placed it as an annual charge against the routes in that State. It is certainly an onerous and extraordinary burden to be imposed on a Company for the privilege of constructing a work that, in its results, must be a great benefit to a large portion of the citizens of that State; but it is a condition, and the Commissioners can do no less than place it to the debit of those routes.

By the Act of May, 1846, the Commissioners are directed to take into consideration "a comparison of the grades or elevations, and depressions and curvatures, in the line or track of said railroad, in the other counties east and west of Sullivan county."

The Commissioners have no means of judging of the curvatures east and west of Sullivan county, except on the routes surveyed under their directions, which present no curvatures so unfavorable in degree, nor much exceeding half the amount, as compared with equal distances.

There are grades, both east and west, more unfavorable than occur in Sullivan county, and it was contended by the friends of the interior route in that county, that this was sufficient, under the Act, to settle the location on that route. Now, (as stated in the preliminary remarks of this report,) it was a matter of public notoriety, before the Act was passed, that grades equally heavy as those in Sullivan county existed both east and west of it; but as this question has been discussed, and the views of the Commissioners given, in the preliminary part of this report, it is not deemed necessary to enter into further detail here on this point.

If the heavy grades in this county were so situated, in regard to the heavy grades east and west of it, that no material benefit could be obtained by avoiding them, then the construction of the Act above given, by the friends of the Sullivan county route, would, no doubt, be in accordance with the intention of the Legislature. But inasmuch as they are so situated that heavy extra expense would be incurred in conducting the traffic of the road over them, such construction would be equivalent to the position, that serious obstacles on one part of the line were sufficient reason that others of the same kind constitute no impediment to the enterprize, which position is considered as inadmissible, in view of the general object of the Act. It is well known that the heavy grades which occur on several parts of the route of the New York and Erie railroad, have been great impediments in the progress of that enterprize; and, consequently, its friends have endeavored to reduce such obstacles as much as possible. The application for the law establishing this commission had its origin in this effort, and the original law (of which the present is an amendment) had a reference to the same object, namely: to remove some of the impediments (of this character) to the progress of the improvement. The Commissioners are, therefore, fully of the opinion, that the construction they have given to the Act is the proper one, namely: that "this fact is to be candidly considered, and to have its due influence on their decision, but cannot control irrespective of all other facts that bear on the question;" and especially cannot do away with the main object of the Act, which was, to determine whether those grades could be adopted "without great prejudice to the public interest."

The Commissioners are further required to take into consideration, "the several Acts of the Legislature of this State in granting aid to the said Company, and especially the provisions of the Act mentioned in the first section of this Act."

The Act incorporating the New York and Erie Railroad Company was passed in 1832. It authorized the construction of a railroad through the southern tier of counties, and forbids any connexion with railroads in the States of Pennsylvania and New Jersey without the consent of the Legislature of this State. Stock sufficient to organize the Company not being obtained, a subsequent Act was passed, authorizing an organization when one million of dollars was subscribed to the stock. No progress having been made in 1834, the Legislature authorized a survey of the route for said railroad at the expense of the State. In 1835, an Act was passed authorizing the Company to construct and put in operation such sections of the road as they might deem eligible.

The powers and privileges granted by the several Acts of the Legislature, and prospects of remuneration from the business of the road having failed to command private capital sufficient for the work, "an Act to expedite the construction of a railroad from New York to Lake Erie," was passed in 1836. This Act authorized a loan of the State credit for three millions of dollars, to be advanced in several sums, on the completion of certain sections of the said railroad.

This Act did not secure much progress in the construction of the road. Private capital could not be obtained sufficient to complete the "first section" of road necessary to obtain any portion of the loan of the State credit.

In 1838, the Legislature passed an Act to amend the Act of 1836, above mentioned. This Act authorized the loan of the State credit to be made, in equal sums with, and after the expenditure of, private subscription; to commence after the Company should expend three hundred thousand dollars.

In 1840, an Act was passed to amend previous Acts; authorizing a six per cent. State stock to be loaned to the Company, and the stock to be issued on the expenditure, by the Company, from their own means, of half the amount of the same.

Under this Act, the Company proceeded with the work until the loan on the credit of the State was issued, to the amount of three millions of dollars, as authorized by the several acts above mentioned. Failing to command the requisite means to carry forward the enterprize from subscriptions to the stock of the Company, after the State loan was exhausted they were unable to proceed with the work, and, early in 1842, notified the State authorities that they were unable to pay the interest on the State loan. This circumstance authorized the Comptroller of the State to sell the road and its appurtenances after six months notice. The sale was postponed by the authority of the Legislature. At this time the Company were practically insolvent, and had no more than a nominal existence. But the Legislature did not seem disposed to abandon the project, and, in 1843, passed a law authorizing the said railroad Company to issue bonds to the amount of three millions of dollars, and giving these bonds priority to the State lien. Also providing, that the State may take the road on certain conditions, when finished; and if the State should not elect to take the road on such conditions, then, the said Company to be released from all liability for the payment of the State stock heretofore issued to them, and amounting to three millions of dollars. After the passage of this law, a new Board of Directors were elected, composed of highly intelligent, honorable, and influential citizens, who made vigorous efforts to raise the funds necessary to carry forward and complete the enterprize. Capitalists, however, did not feel sufficient confidence in the success and productiveness of the enterprize to furnish the necessary funds; and the Board who had taken the direction, finding they were not sustained in their efforts, yielded the administration of the affairs of the Company to others. Nothing, however, in the way of progress was accomplished, and the work remained stationary until 1845. At that time, it became obvious that no further progress could be made by private enterprize, unless inducements could be presented that would secure a large addition of subscriptions to the stock of the Company, under which a new organization could be effected, and a new impulse given to the project. This was the condition of the enterprize when the Act of 1845 was passed—the Act we are called upon particularly to consider.

This Act passed May 14th, 1845, provided, that a new subscription to the stock of the Company should be obtained to the amount of three millions of dollars, and, under certain restrictions, bonds were authorized for a like amount. It provides for a release of the lien of the State on account of the loan of its credit for three millions of dollars, provided a single track road be completed within six years from the passage of the Act. It established a commission of three persons, who were authorized to survey and examine the routes between the summit of the Shawangunk and Deposit, and decide whether a practicable route did exist, and one that could be adopted "without great prejudice to the public interest;" but did not authorize any location out of the State as a substitute for that through Sullivan county.

The same commission was authorized to examine the routes between Deposit and a point one mile westerly of Binghampton, with power, under certain circumstances, to locate on the route by the Great Bend of the Susquehanna, passing so far in the State of Pennsylvania as might be necessary for that route.

At the time this Act was passed, an Act had been passed by the State of Pennsylvania, authorizing the said Company to construct a portion of their road in that State, so far as necessary to occupy the route by the Great Bend of the Susquehanna; but they had not authorized the Company to occupy any portion of that State in the valley of the Delaware river.

To induce the subscription of three millions, and thereby secure the completion of the railroad, the Legislature of 1845, by the Act above mentioned, prospectively gave up the lien of the State for the three million loan, on the conditions above mentioned; they authorized, under certain restrictions, the railroad to pass through a portion of Pennsylvania, and thereby secure a more favorable line; also to consolidate the old stock.

Under this Act, the Company and its friends undertook to revive the affairs of the enterprize. The first proceeding was to obtain the subscription of three millions of dollars to the stock of the Company; without this, nothing could be done. The steps taken to procure it, showed that many persons were more ready to advocate the project than to furnish funds to carry it forward, and (notwithstanding the State prospectively released its lien on the road—the old stockholders submitting to a loss of half their stock—having the prospect of being allowed an improved route for an unfavorable portion of the line) they did not succeed in accomplishing this preliminary step without great efforts, continued for months together; and their final success may be attributed far more to the general influence the road was expected to produce on the trade of New York than to the dividends that would be made from its earnings.

The Commissioners can regard the law of 1845 in no other light than as emanating from a desire, on the part of the Legislature, to offer such further inducements to private capital as would be sufficient to secure the early accomplishment of this great improvement, and thereby afford to a large district of the State, now very much secluded, the means of easy communication to and from our great commercial centre. Subsequent events have proved that the inducements offered were barely sufficient to obtain the requisite subscription, upon which the new organization has been established. To show the slender hold the new subscription had on the stockholders, it is only necessary to mention that, before and at the time the decision of the Commissioners was made on the question of location, shares of stock, on which 20 dollars had been paid, could be purchased in the market for two dollars. In this state of the affairs of the Company, they were not in a condition to encounter difficulties which they regarded as onerous and unnecessary, and from which they had indulged the hope of being relieved. The Commissioners cannot say the work would have been abandoned if their decision had confined the line to this State; but, under the circumstances that existed, they were of the opinion, that such a decision would have put in jeopardy the progress of the enterprize.

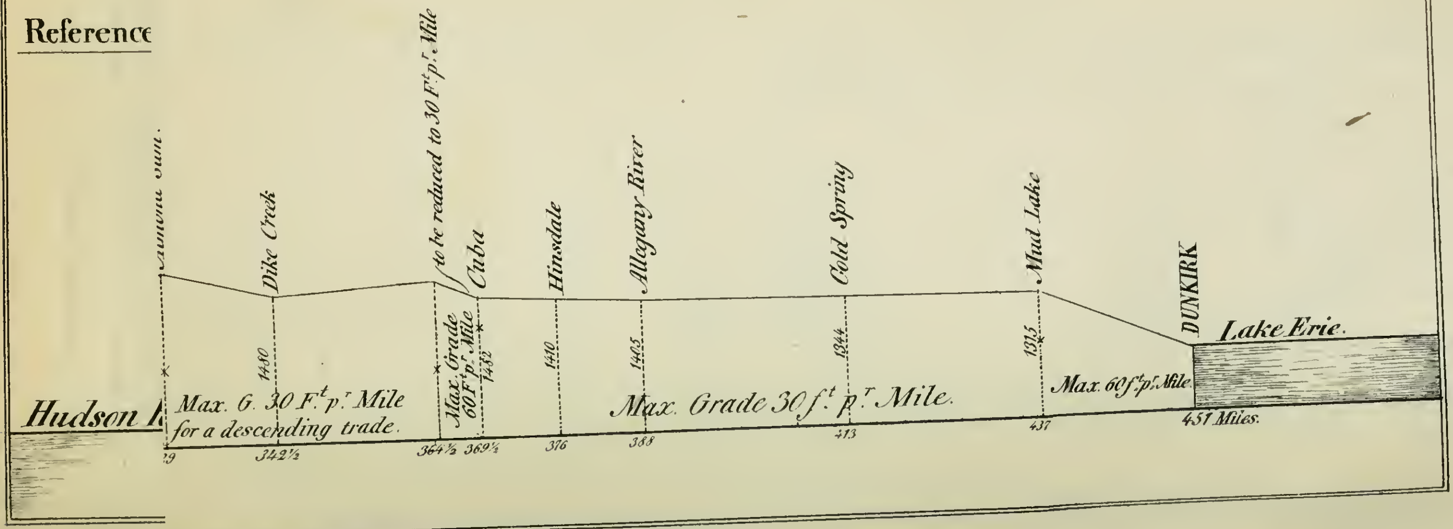
It was clearly the intention of the Legislature to confine the route to this State, unless it should be found there were urgent considerations for carrying some portions of it through Pennsylvania, and the Commissioners were, without exception, extremely desirous of confining the location to this State It was an unpleasant duty to carry the line into another State, that demanded compensation for the benefits that would be conferred on her citizens; while a portion of our own, that had contributed their exertions to secure its benefits, were thus deprived wholly, or in part, of the anticipated advantages. The law, however, under which this commission was established, contemplated the contingency of such decision. It was doubtless framed in view of the necessity that might be found to exist to abridge the benefits to a comparatively small number, in order to make it more beneficial to the public, and to secure the accomplishment of a great work that would confer its benefits on a large portion of the population of this State.

To illustrate the views of the Commissioners as to the influence the extra cost of conducting the traffic will have on the prosperity of the project, they remark:—

First.—It cannot be expected that an enterprize of this magnitude will be undertaken by private capital without a fair prospect of reasonable remuneration for the outlay required.

Second.—If the road be constructed in such a manner as to involve large expenses in conducting a given traffic, such expenses must be charged to those interested in the traffic, and, consequently, the value

Plate II. Vol. XIII. 3rd Series.



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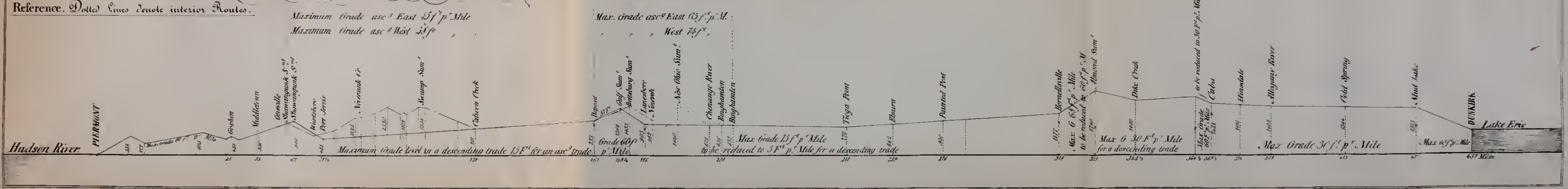
Profile of the New York & Erie Rail Road.



Lith. of Wagner & M^c Guigan 116 Chesnut St. Phila.

of the improvement to the community who use it, depends on the economy with which its business may be conducted.

Third.—Whatever tends to increase the cost of conducting the traffic of a road, reduces its power of competing with other roads, or other modes of conveyance, and consequently diminishes its prospects of business and the inducements to prosecute the enterprize.

Fourth.—The facts and computations, before presented, show that the interior routes would involve annually a heavy extra expense, materially affecting the prospects of the enterprize, and consequently hazarding its success.

The legislation of this State is a full demonstration of the difficulty that has attended every effort to obtain from private sources the funds necessary to carry forward this work, and the necessity of relieving it from every natural impediment, in order to accomplish the main object for which it has been undertaken; and although in the origin of the enterprize the Legislature was disposed to confine the line strictly to this State, in the progress of the undertaking, subsequent Legislatures have found it expedient, in order to secure to a large portion of the State its benefits, to recognize the possible necessity of some departure from the original design, and hence the establishment of this commission to ascertain the facts, and make such decision as the exigencies of the case should require.

That the river routes, when contrasted with the interior routes, have the decided advantage, cannot admit of a doubt, and with that fact established, the only remaining question which presented itself, was, whether the Commissioners were authorized by the Act to sanction those routes.

The Commissioners were required to adopt the interior routes, provided it can be done " without great prejudice to the public interest," &c. In arriving at this conclusion, they are required to consider :—

First.—" The public interest of this State." The public interest is doubtless promoted by the adoption of the route that will be most likely to secure the early construction of the railroad, and render the improvement most beneficial when completed. From the considerations and comparisons presented in the preceding pages, the Commissioners believe the interior routes, if adopted, would be greatly prejudicial " to the public interest of this State."

Second.—" The interest of the citizens of this State who, in their (the Commissioners') judgment, will be affected by the construction and location of said railroad, collectively considered." In examining this branch of the question, the Commissioners do not propose to notice remote interests.

There is, no doubt, a considerable number of citizens of this State that will be affected by the road, beyond the limits that are considered as specifically demanding consideration; but as these will have about the same relative bearing on the question with those more directly interested, it is not considered necessary to refer more particularly to them.

It can hardly be said that any portion of the citizens of the southern tier of counties will be injured by the construction of the railroad on either route. Some portion will be less benefited by the adoption of one route than by the adoption of the other, and comparatively a very small number on either route may not be benefited at all, except the road be constructed on the particular route in which they may be interested. The latter can only be those who are so situated that they would only use the road in the event of its being constructed on the route nearest to them. The great mass of the citizens in the southern tier of counties must be benefited by the construction of the road on either of the proposed routes, and consequently are interested in such measures as will secure its early completion.

The total number of citizens residing on the routes affected by the question of location, or so near that their trade, after the construction of the railroad, would seek it as their avenue to market, is estimated by the census of 1845 at 294,599. Of this number, 45,592 will be less benefited by the adoption of the river routes than by the adoption of the interior routes, and 249,007 will be more benefited by the adoption of the river routes than by the adoption of the interior routes; or, the ratio is nearly as 16 is to 84. Of those who will be less benefited by the adoption of the river routes, about 72 per cent. will have the benefit of the river route on the Delaware, which will be common to them with citizens west of Binghampton, and will materially lessen their diminution of benefits. The amount of diminution of benefits, compared with equal population, appears on the average to be about the same, whichever route be adopted.

There is another portion of the citizens of this State who are directly interested in this question of location, namely: those resident in the city of New York.

This city has an interest in enlarging and securing the trade of the district that will be affected by the construction of the railroad, and it looks not only to that portion in this State, but also to that which will come from the northern part of Pennsylvania, (numbering about 100,000 people by the census of 1840,) and from Lake Erie. The citizens of New York city cannot be overlooked in considering this question, they are a portion of this State, and have an equal right to be considered under the Act, so far as their interests are involved; they are chargeable in all cases of State tax, in which they contribute about one-third of the total amount collected by the State. That their interest is peculiarly important in this enterprize is manifest from the fact, that almost the entire reliance, so far as individual means are required, must depend on them. Whatever risk of private capital the undertaking involves, must fall on them. The road may be a great benefit to the district through which it may be constructed, and yet afford a very inadequate return to the private capital invested in its construction. A due regard to this interest is not only important and proper in itself, but also as affecting the entire success of the project, as may be inferred from remarks in a preceding part of this report. The interest of the city of New York, whether regard be had to the benefit its trade will derive from the operation of the railroad, or the remuneration the traffic will afford for the capital invested in its construction, will be best promoted by the adoption of those routes that will secure the best and most expeditious means of communication. This city, therefore, will be most benefitted by the adoption of the river routes.

The adoption of the river routes greatly improves the general prospects of the railroad, and presents very fair prospects for its early completion. The adoption of the interior routes would materially diminish its usefulness and value, if constructed, and, moreover, by the discouragement it would throw on the stockholders, would hazard the success of the enterprize. The latter remark cannot be regarded as unimportant, when it is considered that the new stock of the Company can now be purchased in the market at 20 per cent. discount, though only 25 per cent has yet been paid in.

In view of the facts that have been presented, and the reasoning based on those facts, after careful deliberation, in full Board, a majority of the Commissioners decided that the interior routes, through Sullivan and Broome counties, could not be adopted for that portion of the said railroad, "without great prejudice to the public interest of this State, and the interest of the citizens of this State who, in their judgment, will be affected by the construction and location of said railroad, collectively considered." And, in accordance with the requirements of the Act, they have filed such decision in the office of the Secretary of this State.

JOHN B. JERVIS,
HORATIO ALLEN,
JARED WILSON,
WILLIAM DEWEY.

French Railway Regulations.

The "Moniteur" contains a Royal ordinance issued on a report of the Minister of Public Works, fixing the general regulations that are henceforward to be observed by all railway companies in working their lines. The following are the principal points referred to:

The Way.—The stations are to be considered part of the public domain, and as such, to be regulated by the superior authorities. The entrance, the circulation, and the standing of public or private carriages, are to be subjected to the decisions of the Minister of Public Works. The repairs of the way, and of the works depending on it, though evidently at the discretion of the Companies, are to be made known to the Government authorities, who can interfere when anything is unsatisfactory. The crossings and passages on the line are to be subjected to Government regulations, particularly in what relates to the barriers required for the latter. High embankments, viaducts, and bridges over rivers and streams, are to be defended by strong parapets. All stations, passages on the level, &c., are to be well lit up.

The Working Stock.—Locomotives are, in the first instance, to be subjected to certain proofs of strength, for the boilers, axletrees, wheels, &c. They are to be provided with an apparatus to catch the pieces of coke falling from the furnace, so as to prevent their reaching the ground. Every means must also be employed to prevent sparks from issuing from the funnel, whereby property along the line has from time to time been set on fire and consumed. The report regrets that the grating at present in use is not found to be efficient. Axletrees are in all cases to be made of wrought iron, of the first quality.

Composition of Trains.—All Companies are bound to furnish a sufficient number of carriages of every description to supply the wants of each station. The hours fixed by the Company for departure are to be rigorously observed. As the public, in a great measure, are dependent on railways for their mode of transport, these two regulations are absolute on all Companies whatever; when any exception to this rule is permitted, as in the case of direct trains, it is the Government authorities who must regulate the matter. In case of *fete*, or extraordinary movement from one point to another, the Company is obliged to provide an additional and sufficient number of carriages of every class; the number of carriages for a single train is not to exceed 24, and this is to be considered rather as the exception than the rule. Double locomotives are permitted, as otherwise trains would be multiplied to a dangerous extent. But whenever the second locomotive is employed, the cause of such proceeding must be entered in a book kept for the purpose. No matters liable to explosion are to be transported in a train in which passengers are carried. A means of communication must always be established between the conductor and the engine-driver.

Departure, Circulation, and Arrival of Trains.—A number of articles refer to the measures of precaution to be used in starting trains at proper hours, so as to leave a sufficient time between each; the maximum of speed; the precautions to be taken in passing through tunnels, &c. They also regulate the passage of extraordinary trains, the obligation of communication by signals, and the general superintendence of the line. Registers are to be kept at every station for marking down the causes of all delays. No train is ever to leave before the hour appointed in the printed lists.

Fares.—The conditions of the concession generally regulate the tariffs; but a Company may lower its prices if it thinks fit, subject, however, to the condition of keeping them so, for a certain time. As a general rule however, no changes whatever can be made by the Company without first submitting them to the Government authorities. Railways that have been conceded prior to 1835 will not be subject to these regulations until April 1, 1847. Equality of charge is to be strictly enforced, as otherwise the Companies would become unjust to one locality at the expense of another.

Regulations relating to Passengers.—All persons unconnected with the Company and the service are forbidden to enter the premises of a railway without permission, or to there stand or circulate, or to place there objects of any kind, or to introduce horses, dogs, or other animals, or to cause vehicles of any kind to circulate there. Government authorities are an exception to this clause. Passengers are not to lean out of carriages, or pass from one to another, or carry loaded fire-arms, or leave a carriage when in movement. The other prescriptions are generally similar to those in force for common carriages.

General Arrangements.—No person can sell anything within the precincts of a station without permission from the authorities. When a line crosses several departments, the attributions conferred by the present regulations on the several Prefects may be concentrated in one. Every person employed by a Railway Company must wear a uniform, in order that the public may at once see, in case of need, to whom they are to apply. *Signal-men, guards, and barrier-keepers* may wear *a sabre.* At each station a book must be kept to receive the complaints of passengers. Copies of the present regulations are to be constantly kept placarded in all stations; copies are also to be given to each person employed, and whatever relates to passengers is to be hung up in each carriage.

Lond. Railway Mag.

Menai Tubular Bridge.—Experiments at Blackwall.

We have on one or two recent occasions witnessed experiments made on the huge model of the proposed tubular bridges of the Chester and Holyhead railway, under the able direction of Messrs. Hodgkinson and Fairbairn, when several other eminent engineers were present. The principal object of the present experiments has been to ascertain the proper proportions of the sectional areas of the top and bottom of the tube. Great additional strength has been obtained by stiffening the side plates with vertical ribs of T iron, attached at equal intervals throughout the whole length of the tube.

In the first experiments, the sectional area of the bottom plate being 22½ square inches, of the top 24 square inches, and the sides 10 inches, a weight of 58 tons produced a deflexion of 3·2 inches. This weight was allowed to remain till the following morning, and the increase of deflexion was found to be inconsiderable. The tube being subsequently laid on its side, in order to test its lateral strength, it was found that 9 tons produced 2 inches deflexion, and 12 tons, the last load laid on the tube in that position, produced 3⅝ inches total deflexion, including that due to the weight of the beam itself.

In the concluding experiments, Dec. 23, it was determined to load the model bridge till it was broken. The following table exhibits the deflection corresponding to each load:—

Experiments.	Load.	Deflexion.
No. 1,	31,612 lb.	0·70 inches.
2,	57,947	1·31
3,	83,310	1·91
4,	105,362	2·38
5,	117,326	2·77
6,	125,927	2·96
7,	135,255	3·17
8,	Same weight after remaining 9 days	3·22
9,	139,567	3·38

Experiments.	Load.	Deflexion.
10,	144,352	3·48
11,	149,684	3·70
12,	151,772	3·81

With the last load, equal to 67¾ tons, the beam broke.

In order to a right apprehension of the manner in which the fracture took place, it must be understood that the thickness of the bottom plate had been greatly increased near the middle point of the model by additional plates, which were continued for 20 feet on each side of the centre; and it was where the thin part, or single thickness of the bottom plate, commenced, that fracture took place. The bottom plate was torn asunder with a very irregular line of fracture, not contiguous to the rivets. The vertical or side plates also gave way, but in them, the rivets (24 on each side, of $\frac{5}{16}$ iron) were actually cut or sheared asunder, the rivet-holes being uninjured. The top or cellular plate remained perfect.

These experiments have suggested several improvements of details in the bridges to be constructed over the Menai and Conway: but at present the modifications are not defined sufficiently to be laid before the public. The utmost precautions have been taken to secure the strength and stability of the proposed structures. The greatest credit is due to the skill and perseverance displayed by Messrs. Fairbairn and Hodgkinson, and other gentlemen called in by Mr. Stephenson to carry on the investigation, and also to the liberality with which expensive models have been provided. Civ. Eng. & Arch. Jour.

An Extract from an Historical and Geographical Examination of the Isthmus of Panama: The different directions in which it may be cut, and the means to be employed. By MICHEL CHEVALIER. *Paris, published by Charles Gosselin*, 30 *Rue Jacob*, 1844.

Translated for the Journal of the Franklin Institute, by Persifor Frazer, Esq.

Nicaragua Route.

Measured from shore to shore, at the port of San Juan de Nicaragua, the distance between the two oceans is 150 kilometres; (93·25 miles;) obliquely from San Juan de Nicaragua to San Juan of the South, it is 250 kilometres; (155·50 miles;) and from the same point to Realejo, more than 400 kilometres; (about 250 miles;) all in a straight line. But a great convulsion of nature has opened in the midst of the land the bed of a spacious lake, that of Nicaragua, an inexhaustible reservoir, which, by the wide and deep river San Juan, empties itself into the Atlantic, and seems a prolongation of that ocean into the interior of the continent. The two seas thus approach each other very nearly, and two bays, that of Papagayo and that of Nicoya, indent the shore of the Pacific as though that ocean would, in its turn, assist in opening the communication. Beyond the river and the lake, the traveler coming from the Atlantic arrives at another lake, that of Leon, (or Managua,) terminated to the north by a sort of crescent, whose extreme north west point (that on which was formerly situated the town of Leon, now transported into the interior, and where is now the port of Moabita) is nearer to the Pacific than any point of lake Nicaragua, as the distance thence to the port of Tamarindo is but 14 or 15 kilometres; (about 9 miles;) this last lake discharges itself into the former by the river Tipitapa. Finally, on the coast of the Pacific, near the lake of Leon, is the port of Realejo, of which it was formerly said, that it was "excelled by none within the dominions of Spain." These fine lakes and noble rivers communicating with each other, remind us of those situated in Scotland, in a gorge between the two seas washing the shores of Great Britain, by the aid of which, a canal sufficiently spacious to receive frigates has been opened. In the same manner, they invite man to open from sea to sea a communication whose importance to the general commerce of the world will be to that of the Caledonian canal about in the same proportion as that which a strait holds to the great ocean, or the island of Great Britain to the continent of the two Americas.

The lake of Nicaragua is 176 kilometres (109·50 miles) in length, 55 (34 miles) in width, and nearly throughout has a depth of 25 metres. (82 feet.) The river San Juan, which, running to the eastward, is a prolongation of the great axis of the lake, has a course of 146 kilometres. (91 miles.) The lake of Leon has for its greater length 63 kilometres, (39 miles,) and a circumference of 147. (91·50 miles.) The river Tipitapa, by which it empties itself into lake Nicaragua, is 55 kilometres (34·25 miles) long. Thus, there is, from the Atlantic to the head of lake Nicaragua, a distance of 322 kilometres, (202 miles,) and to the head of lake Leon 440. (273·50 miles.) The town of Leon, situated 25 kilometres (15·50 miles) from the lake of the same name, is the most populous city of the neighborhood of lake Nicaragua, and, with the exception of Guatemala, of all Central America.

Here the junction of the oceans may be attempted in several directions. 1st. The line may be carried from the city of Nicaragua, on the lake of the same name, to the port of San Juan of the South, on the gulf of Papagayo. 2d. From the same lake to the gulf of Nicoya, also called the bay of Caldera, there is reason to believe that there are facilities for the construction of a canal, by means of the river Tampisque, which empties into that gulf, and by the Sapua, which flows into the lake to the south of Nicaragua. These two rivers, each having an abundant provision of water, approach each other very nearly in the vicinity of the bay of Las Salinas, an arm of the gulf of Papagayo. 3rd and 4th. From the north-west point of the lake of Leon, a communication may be practicable either to the port of Tamarindo, or to that of Realejo. 5th. A line has also been mentioned from the same point to the river Tosta, which is crossed on the route to Realejo, and which descends from the volcano of Telica. 6th. Finally, perhaps a junction may be possible from the north east point of the lake of Leon to the bay of Couchagua. This done, there would remain to be carried into effect, the improvement of the navigation of the river San Juan de Nicaragua, and, in case the route should be through lake Leon, that of the Tipitapa, so as to render them navigable for large vessels. The river San Juan is navigated on its entire length, and during the whole of the year, by pirogues drawing from 1 to 1·20 metres (3 to 4 feet) of water; but, nearly throughout, its depth is much greater. By the improvement of four or five rapids and shoals* which are met with here and there, it would be easy for ships drawing from 3·5 to 4 metres (11 to 13 feet) of water to pass from the sea to the lake. The river being in most places enclosed betwixt banks of a slight elevation, the necessary works would be reduced to a few dams, each of which would be accompanied by a lock. The bar of the river San Juan has on it a depth of 3·5 metres, (11·50 feet,) and there is, according to Mr. Robinson, a narrow pass across it, with a depth of water of 7·5 metres. (23·50 feet.)

The port of San Juan, situated at the mouth, is safe and spacious. Numerous reports of naval officers who have recently visited it, represent it as excellent.† Its salubrity, a very rare advantage along the Atlantic shore of Central America, is generally acknowledged. The trade winds, whose action is not broken by any continuous chain of mountains, sweep away the miasmas which rise in abundance from the neighboring marshes, so completely as to prevent the ravages of the yellow fever. It may possibly not always be so, should a numerous European population be established there. In Central America, the same reproach is made against San Juan de Nicaragua as that made in France against Brest—that it is rainy *par excellence.* In this respect, there is a great difference betwixt San Juan and the port of San Carlos, situated on the lake, at the point where the river escapes from it, and still more so betwixt San Juan and the cities of Grenada, Nicaragua, and Leon, which enjoy a sky always serene; this is, however, an inconvenience which requires nothing more than a passing notice.

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* According to the information communicated to Mr. Stephens, by Mr. Bailey, the state of the river and the distribution of the rapids is as follows: From the lake to the river Des Savalos, a distance of about 33 kilometres, (20·50 miles,) the depth of the San Juan varies from 3·65 to 7·30 metres. (12 to 24 feet.) Then commence the rapids of El Toro, which are 1850 metres (2023 yards) in length, and have a depth of water from 2·75 to 3·65 metres. (9 to 12 feet.) For an interval of 7400 metres, (8100 yards,) we find an easy navigation, but on arriving at Cartillo Viejo, we meet with another rapid which has a length of about 1000 metres, (1100 yards,) and from 3·65 to 7·30 metres (12 to 24 feet) depth of water. After a space of 3700 metres (4046 yards) of good navigation, with from 4 to 4·50 metres (13 to 15 feet) of water, we arrive at the rapids of Mico and Las Balas, which succeed each other, and have, together, a length of 1850 metres; (2023 yards;) the depth of the channel varies from 1·83 to 5·50 metres. (6 to 18 feet.) After another navigable space of 2800 metres, (3062 yards,) come the rapids of Machuca, 1850 metres (2023 yards) long; these are the most dangerous of all, for the river here runs over a bed covered with pointed rocks. To these succeed a natural basin, 18·50 kilometres (11·50 miles) in length, with from 3·65 to 13 metres (12 to 42 feet) of water, which brings us to the junction of the San Carlos. 20 kilometres (12·50 miles) further, the San Juan receives the Sarapiqui, the only communication between the State of Costa Rica and the port of San Juan on the sea. Along this passage some islands are scattered, and the depth is from 1·83 to 11 metres; (6 to 36 feet;) the shallowest points being at the bends of the river, where the mud and gravel have accumulated. Finally, after a further course of 13 kilometres, (8 miles,) we arrive at the separation of the Colorado. Thence to the sea the distance is 24 kilometres, (15 miles,) which may easily be reduced to 18·50. (11·50 miles.) All the soundings given here were taken at low water. It may be remarked that, according to this statement, the length of the river is 129 kilometres, (about 80 miles,) instead of 146, (91 miles,) as mentioned at another place by Mr. Stephens.

The dams to be constructed at each of the 4 rapids will be from 80 to 100 metres (87 to 110 yards) in length. Dredging will be required at some other points.

† The opinion of Mr. Bailey, as given by Mr. Stephens, is that the port is *unexceptionable, but small.* All our other informants agree in recognizing it as of considerable extent. Messrs. Rouhaud and Dumartray say, that "it is *vast, and altogether safe,* which can be said of no other point on the eastern coast of Central America." Some scientific officers of the French navy, who were instructed to examine it in 1843, say, expressly, that it is a *vast and safe shelter, (un asile vaste et sur,)* a beautiful situation, an excellent port, and, they add, a good anchorage close to the land.

We may admit then that the river San Juan terminates at a good port, and that its navigation may easily be improved so as to render it practicable for sea-going vessels drawing, as we have already said, from 3 to 4 metres (10 to 13 feet) of water. As regards this, the past will answer for the future. Tradition assures us that, formerly, sea-going vessels ascended the river San Juan, and, that at the great annual fairs held at Grenada, at the bottom of lake Nicaragua, several brigs, or three-masted vessels, arrived regularly from Cadiz, or other ports of the peninsula, after having touched at Carthagena, or Porto Bello. I am not referring here to one of those false traditions which delight in representing men and things as ceaselessly degenerating. Mr. Rouhaud has verified the fact in the archives of the city of Grenada. He found there evidence that, in the middle of the 17th century, three-masted vessels *(fragatas)* of the Spanish commercial marine frequented the anchorage of *las Isletas*, which is, on the lake, the port of the city of Grenada; and I have seen in his hands original papers going back as far as 1647 and 1648, which prove it. But in 1685, the river underwent a great change, produced by the hands of man. A new channel was forcibly opened, by which, under the name of the Rio Colorado, a considerable portion of its waters escaped. According to the soundings made by Mr. Bailey, as given by Mr. Stephens, the Colorado, when its waters are low, discharges 360 cubic metres (about 471 cubic yards) per second. This is three times the volume of the Seine at Paris, at its lowest stage. When its waters are high, the Colorado discharges 1095 cubic metres (1432·25 cubic yards) per second. Since 1685, the ancient bed of the river, below the point at which the Colorado separates from it, cannot receive boats drawing more than from 1 to 1·20 metres (3 to 4 feet) of water. The Colorado itself is inaccessible to merchantmen, on account of a bar at its mouth which they cannot cross.

It was war, the cause of so many difficulties in the world, that occasioned this revolution in the river San Juan. The Caribbean sea and its vicinity was then infested by buccaneers, who carried every where with them devastation and pillage, with a courage and audacity that one regrets to see in the service of the brutal passions. These robbers laid waste all the Spanish establishments bordering on the sea. To prevent them from penetrating to the lake of Nicaragua, the inhabitants sunk hulls of ships, rafts loaded with stone, and whatever else they could lay their hands on, about 20 kilometres (6·50 miles) above the mouth of the river. The rainy season having arrived, the river, which at that time brings down a great number of trees, uprooted by the current from its banks, increased the obstruction, the sands accumulated, and very soon it became a dyke which arrested the course of the waters. They then sought another channel, and thus the Colorado was formed. When the freebooters were no longer to be feared, an attempt was made to re-open the ancient bed; but it was done in the inefficient manner which too often characterizes a Spanish administration, and the only means which could have succeeded, a dam across the entrance of the Colorado, were not employed. By such a dam, 410 metres (448 yards) in length, which may be constructed as well now as then, and by the improvement of the ancient channel, the river may be made to resume its primitive course and state.

The inconsiderable works which we have summarily indicated for the rapids and reefs of the river above the Colorado, would suffice to render the San Juan de Nicaragua constantly navigable with safety for vessels drawing from 3·50 to 4 metres (11·50 to 13 feet) of water. But this would not be sufficient for such a junction of the two oceans as would be desirable at the present day. Much more extensive works would be necessary to place the river in a state to afford a passage to ships such as those received in the Northern canal of Scotland, and in the Caledonian canal, and such vessels as the transatlantic packets. To attain this end, it might possibly be necessary to renounce all idea of a navigation in the bed of the river for a great portion of its course, and to excavate a lateral canal. The ground is favorable for so doing, but by reason of the dimensions of the cut, the expense would be great; Mr. Stephens estimates it, probably from Mr. Bailey's observations, and in adopting a series of prices about the mean of those of the United States, at 10 or 12 millions of dollars. That is about one-half of the sum which would be required, according to his calculations, to establish the communication between the two oceans from the port of San Juan de Nicaragua to San Juan of the South.

The Tipitapa offers facilities even greater than those of the San Juan de Nicaragua. It appears generally to be closed in like a canal; there would be but about 50 metres (55 yards) of dam to be constructed. In a length of 55 kilometres, (34·17 miles,) it has a fall of 8·74 metres. (28 feet 8 inches.) The half of this fall is at one spot, the town of Tipitapa, near the lake of Leon, where there is a cascade of 4 metres. (13 feet.)* M. Rouhaud has expressed himself, in reference to the site of this town, in terms of the liveliest enthusiasm. He represents it as one of the best possible localities for a great city; a plain—yielding in abundance, at the same time, products the most valuable and the most usual, indigo of the finest quality, and maize in the ratio of 400 to 600 grains for one, spreads out here to a great extent. The town is placed *(à cheval)* between the two lakes, one may almost say, between the two seas, and the fall of the river furnishes an inexhaustible water-power for manufacturing purposes. But when will human industry display its miracles of activity in this enchanting spot? Will it ever establish here its residence and fix its empire? Mr. Stephens, proud as he is of the prowess, in matters of industry, of the Anglo-Saxon race in general, and of his countrymen, the North Americans, in particular, when he found himself beneath this dazzling sky, in presence of the limpid waters and graceful shores of the lake, surrounded by this prolific nature, offering in profusion all the necessaries of life, when he felt himself bathed by this soft air, which inclines the soul to reveries and the body to repose, he despaired even of the restless energy of the Anglo-Americans, and expressed a doubt whether those intrepid champions of industry, transplanted to such a home, would be able to resist its seductions, nor abandon themselves to the idleness they despise. Neither does the necessity of crossing lake Nicaragua appear to be an objection to this route, although it has been said to be liable to sudden squalls of great violence; decked vessels would be in no danger from them. They would be *perfectly* safe if towed by steamers, the same which had brought them up the river San Juan, and the towing across the lake would naturally be effected with a very trifling addition to the expense; in return for which, there would be an economy of time.

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*According to Mr. Stephens, the whole of the fall of the Tipitapa, amounting to 8·74 metres, (28·67 feet,) is comprised in the first 10 kilometres (6·25 miles) below lake Leon; M. Rouhaud, who took a part in the topographical operations executed in the country, has told me that the fall of 8·74 metres (28 feet 8 inches) is divided as follows: 5·49 metres (18 feet) in one fall at Tipitapa, and the remaining 3·25 metres (10 feet 8 inches) between Tipitapa and lake Nicaragua.

It remains to ascertain what difficulties are offered by the barrier to be surmounted between lakes Nicaragua or Leon, and the Pacific.

There is no country so covered with volcanoes as is this part of America between the 11th and 13th degrees of north latitude; but on the right of lake Nicaragua, the mountains, by whose craters the subterranean fire finds a passage, are in small isolated groups, and sometimes in solitary peaks; they spring up from the plain, leaving between them valleys, or at least passages. This narrow tongue of land which separates lake Nicaragua from the Pacific, strewed, as it is, with gigantic peaks, affords at their base a surface of no great elevation. The accounts of the celebrated navigator Dampier, who fought in these regions, lead us to believe that along the different routes from lake Leon to Realejo, and from lake Nicaragua to the gulf of Papagayo, or to that of Nicoya, the ground is generally even and in savannahs, and that between lake Leon and the coast of Realejo, the natural soil is altogether flat. Mr. Stephens also, speaking of his personal impression, says, that the soil is perfectly level. M. Rouhaud has spoken to me in the same terms of the space comprised between the northwest point of lake Leon and the port of Realejo; and of the ground extending from the same point of the lake and the port of Tamarindo. He estimates at 6 or 7 metres (20 or 23 feet) the height of the bank above the surface of the water; then comes, he says, a little zone, perceptibly level, and thence you descend gently towards the Pacific ocean. This unanimity of opinion is encouraging; nevertheless it is not sufficient to dispense with the necessity of an exact leveling; without this, there can be no certainty. The eye of even an experienced observer appreciates with difficulty the rise of ground when the ascent is gradual. Mr. Humboldt says "nothing is more deceiving than the judgment one forms of the difference of level on a prolonged, and consequently gentle, slope. In Peru, I could hardly believe my eyes on finding, by means of a barometric observation, that the city of Lima is 91 toises higher than the port of Callao." The mango-trees *(mangliers)* that Dampier saw on the route from Realejo to Leon, are a certain index of a low and humid soil; but he does not say that he observed them along the whole line.

Of the various lines above mentioned, one alone has been examined by geometrical observations.

(To be continued.)

AMERICAN PATENTS.

List of American Patents which issued in the month of April, 1846,—with Exemplifications, by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For *Improvements in Cutting Screws on Bedsteads, &c.;* Hezekiah P. Nuckols, Glasgow, Kentucky, April 4.

Claim.—"Having thus fully described my improvement, what I claim therein as new, and desire to secure by letters patent, is the combination of the right and left-hand screw cutters with the frame for tapping and boring, substantially in the manner set forth, so that they can be brought into action or removed at any required time, as described, and designate the proper angle for the frame."

2. For an *Improvement in the Gate for Railroads;* David Percival, Middletown, Delaware, April 4.

The gate is so constructed as to slide vertically, and is connected with inclined beams on the side of the rails, which, when depressed by the passage of a car over them, depress the gate, and then permit it to rise when the car has passed.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combination of a balance gate with a railroad track, by means of the vibrating beams, combined, constructed, and operating with the same substantially in the manner and for the purpose set forth."

3. For an *Improvement in Sulkey Carriages;* J. R. Remington, Lownds county, Alabama, April 4.

This is a one-wheeled carriage, the shafts of which are so constructed nd connected with the harness on the horse as to balance it on the ne wheel and prevent it from upsetting.

Claim.—"Having thus fully described my improvement and its peration, what I claim therein as new, and desire to secure by letters atent, is constructing the shafts of a one-wheeled carriage, and con ecting them with the horse, substantially in the manner and for the purpose set forth."

4. For an *Improvement in the Filtering Cock;* Thomas F. Wenman, New York city, New York, April 4.

The valve of this cock is a hollow cone divided into two chambers by a filtering partition, so that the liquid in passing through shall be filtered.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the filter within the inner cone of the cock, by means of a groove made in the inner cone; also, on the bottom plate placing the two perforated plates, with the filtering substance between them, so that all the water, or other liquid fluid, has to pass through the plates and filtering substance above named, substantially in the manner and for the purpose described."

5. For an *Improvement in the Method of Constructing Trunks;* James Hibson, New York city, New York, April 4.

The patentee says,—"My improvement is confined to the skeleton, or frame-work, of traveling and other trunks, and to the mode of connecting thereto the exterior covering. Instead of constructing the ribs (which constitute the skeleton of such trunks,) of wood or metal, I use strips of whalebone, which, by its elasticity, preserves the original shape of a trunk after the latter has been subjected to wet or accidental pressure. These strips, when bent to the required form, are secured to the iron lips of the trunk by having their ends inserted into sockets formed of sheet metal, and riveted to the lips. The lips are united at one side, by metallic or other hinges, in the usual manner. To connect the outer, or leather, covering to the skeleton, I use small clamps, made of thin sheet metal."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the whalebone ribs, and the mode of combining them with the frame-work of the trunk."

6. For a *Process for Purifying or Cleaning Whale Oil;* Patrick Fitzsimmons, West Troy, New York, April 4.

For the purpose of precipitating the gelatine and albumen, finely pulverized alum is mixed with the oil. The proportion of alum for a hundred gallons of oil is from fifteen to twenty-five pounds, according to the quality of the oil.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of separating the impurities from whale and other animal oils by means of alum, under the treatment substantially as herein described."

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7. For an *Improvement in the Filtering Stop-cock;* Jonathan F. Ostrander, New York city, New York, April 4.

Claim.—"I do not claim the placing of a filter in the plug or core of a stop-cock; but what I do claim as my invention, and desire to secure by letters patent, is the combination of the filtering core with the auxiliary passage, for allowing an unobstructed flow of the water, substantially as herein described."

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8. For an *Improvement in Propellers for Steam Vessels;* Bennet Woodcroft, Manchester, England, April 4, 1846, antedated February 13, 1844.

This is for an improvement in that class of propellers in which the shaft is parallel with the keel, and the vanes or paddles, segments of a helix; and the improvement claimed consists in connecting the vanes with the hub on the main shaft by an arber, to admit of turning, that their obliquity may be varied by the sliding of a box on the shaft connected with the arbers of the vanes by means of arms projecting therefrom, and jointed to the sliding box.

Claim.—"Having now described the nature of my said invention, and the manner in which I carry it into effect, I declare that I do not claim any of the parts separately which I have used in my improvements in propelling vessels; but I do claim as my invention the combination of the blades of propellers, such as I have shown and described, with an apparatus for setting the same, arranged and operating substantially as herein set forth; the sliding box with oblique grooves being made to operate upon arms which are attached to the shafts upon which the propellers are to turn, said sliding-box being made to move back and forth on the propeller shaft by the turning of a rod, or by any other equivalent means."

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9. For *an Improvement in Printing Presses;* Alva B. Taylor, New York City, New York, April 4.

To avoid the shock and jar at the end of each reciprocating motion of the carriage of the Napier press, particularly when it is attempted to operate the press with considerable velocity, air cushions or springs are used, and made by having a piston or pistons attached to the ends of the carriage, so as to compress air in cylinders attached to the frame. These pistons either enter short cylinders at the end of the motions of the carriage, or the cylinders have apertures near the end, so that the pistons are only resisted by the compression of the air towards the end of the motions of the carriage.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described of arresting the momentum of the carriage which carries the form of types in printing presses by means of plungers, that compress air in cylinders only towards the end of the motion of the carriage, as herein described."

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10. For an *Improvement in the Self-Acting Register for Stoves;* Washburn Race, Seneca Falls, New York, April 4.

An expansion rod is connected at its lower end by a knife edge with a lever which is in turn connected with the register, so that as the rod contracts by the reduction of temperature the register is opened, and vice versa.

Claim.—"Having thus fully described the construction and operation of my improved self-acting register for stoves, or close fireplaces, what I claim therein as new, and desire to secure by letters patent, is the manner in which I combine the expansion rod, with the register or valve, by means of the lever, the whole constructed and operating in the manner and for the purpose herein set forth, or in any manner substantially the same, by which the ordinary connecting joints are avoided."

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11. For an *Improvement in Horse Rakes;* Lorin M. Whitman Pike, Allegheny county, New York, April 4.

On the rotating head of the rake and near each end, there is a segment of a wheel with which the head turns that the teeth may be discharged when full, and these segments of wheels are so combined with a stop bar and catches on the frame, as to arrest the head at the required portion of its revolution.

Claim.—"I hereby disclaim the original invention of horse hay-rakes, as heretofore constructed and used. I likewise disclaim the invention of the plan of attaching the lower ends of the handles by a strap of iron passing around the head of the rake.

1st. What I do claim, and desire to secure letters patent for, is the invention and combination of the segments of wheels with the head of the rake, and by which it revolves in the manner substantially set forth in the specification.

2d. I claim the combination of the stop bar and catches with the segments of wheels, to hold the head of the rake in a straight position for raking. And I do hereby further declare that I do not intend to limit myself to the precise size or form of the segments of wheels on which the rake revolves, nor to the shape, size, or length of the head or other parts of the said rake; but I wish to vary the same as I may think expedient, so as to admit of the application of a set of double teeth to the head of the rake on the same principle on which the single tooth is applied, whilst I attain the same ends by means substantially the same; that is, in producing a revolving spring tooth, horse hay-rake, with a stop bar and segments of wheels to revolve on, &c."

12. For a *Machine for Washing and Rinsing Cloth in Calico Printing;* George I. Prentiss, Tiverton, Rhode Island, April 4.

We are under the necessity of omitting the claim in this case, as it refers to, and is wholly dependent on, the drawings.

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13. For an *Improvement in Propellers for Vessels;* Daniel Deshon, 2nd, New London, Connecticut, April 4.

The paddles are hung by journals to the arms of the wheel that they may turn therein, and to the journals there is an arm extending to the same distance on either side of the axis of, and parallel with, the plane of the paddle, and these arms are provided with wrists that are acted upon by a series of circular projections on the rim of the wheel for the purpose of turning the paddles that they may present their surface to the water at the point of maximum propulsion, and feather when passing through that portion of their circuit in which they are not required to propel the boat.

Claim.—"Having thus fully described my improvements, what I desire to secure by letters patent, is the method of turning the paddles, as herein described, by means of a revolving ring having guiding projections thereon, around which the wrists on the arms of the paddles play in the manner and for the purpose set forth."

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14. For an *Improvement in Railroad Wheels;* Thomas Glasco, Wilmington, Delaware, April 4.

This is for a mode of fastening the treads or tyres of railroad wheels to the main rim, or "centre" as it is termed in the specification before us. The outer periphery of the "centre" is made conical to fit the correspondingly formed inner periphery of the tread, and the outer periphery of the "centre' or inner rim is grooved to receive a ring cut in three parts, so that when the outer rim or tread is slipped on, by means of radial screws, the segments of the ring can be forced into a groove in the inner periphery of the outer rim; one face of the segment ring being beveled so that, when forced out, they (the segments) shall act as wedges to force the outer on to the inner rim.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of connecting the centre with the rim by the circular wedge, which is divided into three parts, and fastening the same by the screws, as described in the specification."

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15. For a *Machine for Moulding Bricks;* Joel L. Ransom, Millport, New York, April 4.

We are under the necessity of omitting the claim of this patent because of its reference to, and dependence on, the drawings. The machine is for moulding bricks of tempered clay.

16. For a *Churn;* Charles King, Scipio, Cayuga county, New York, April 4.

There is a vertical dasher which by means of a handle can be made to move up and down, and through slots in this pass the arbers of two vibrating dashers which have their bearing in the wash box, and these are made to strike the clothes placed between them and the vertical dasher, by having the vibrating dashers connected with the vertically sliding one, so that as the one is moved up and down the other shall alternately strike the side of the vertical dasher.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the vertical dasher with the oscillating dashers, constructed and operating in the manner and for the purpose herein set forth."

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17. For an *Improvement in the Spring Lancet;* Jacob H. Gemrig, Philadelphia, Pennsylvania, April 11.

The Lancet is formed at the end of a slide that works in a case, the metal slide having a stem that passes through the case to receive a helical spring by which the Lancet is forced out, and the case being provided with a spring catch to hold when drawn back into the case. The whole is put into a case somewhat similar to a pencil case.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the several parts of the instrument, viz: the blade and the sliding frame, the spring catch, and the spiral spring; and, in combination therewith, the mode herein set forth of regulating the length of the stroke of the blade."

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18. For *Improvements in the Brick Press;* Thomas Hartly, Pittsburg, Pennsylvania, April 11.

The machine for reducing the clay consists of two toothed cylinders, the teeth of which play into each other and between the bars of a grate, and after the clay is delivered from these it is acted upon by another toothed cylinder, the teeth of which play between the teeth of a concave. The moulds are formed in a rotating platform, and the bricks are pressed from above and below, the upper followers not being permitted to descend into the moulds.

Claim.—"Having thus fully described my improved brick machine, what I claim as my invention, and desire to secure by letters patent, is the combination of the rollers, adjustable grate, and concave, for grinding mortar, substantially in the manner and for the purpose de scribed.

"I also claim the combination of the revolving moulds and pressing apparatus, pressing the brick on both sides, the upper follower not entering the mould, as herein described, by which a perfect brick is made, sufficiently pressed on both sides; and great rapidity of operation is secured, substantially in the manner above made known."

19. For *Improvements in the Combination Lock;* Joshua H. Butterworth, Dover, New Jersey, April 11.

The following claim will enable the reader, if acquainted with the principle on which combination locks operate, to understand fully the nature of the improvements patented.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the arrangement of the circular plates, for elevating the tumblers into notches in the main bolt, and raising and lowering the levers, which act upon the movable talon, in combination with the movable talon and the preventive stop or flying tumbler; all as herein set forth."

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20. For a *Magnetic Telegraph;* Samuel F. B. Morse, New York city, New York, April 11.

Claim.—"What I do claim as my invention, and desire to secure by letters patent, is the receiving magnet, or a magnet having a similar character, that sustains such a relation to the register magnet, or other magnetic contrivances for registering, and the length of current or telegraphic line, as will enable me to accomplish, with the aid of a main galvanic battery and the intervention of a local battery, such motion or power for registering as could not be obtained otherwise without the use of a much larger galvanic battery.

"I claim as my invention the use of a local battery and magnet, in combination with a battery and magnet connected with the line or lines of conductors, for the purpose above specified.

"I also claim the combination of the apparatus connected with the clockwork for setting off the paper, and stopping it with the pen lever.

"I also claim the combination of the points affixed to the pen lever with the grooved roller for marking on paper, as above described."

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21. For an *Improvement in the Lamp for Light Houses;* Charles Wheeler, Rockport, Massachusetts, April 11.

The object of this improvement is to avoid the necessity of using a stove in light houses during the winter to prevent the condensation of vapor on the glass.

A small auxiliary lamp is placed below the reservoir of oil which supplies the light house lamps, and from this auxiliary lamp a small tube passes up through the reservoir of oil.

Claim.—"I do not claim merely the use of an auxiliary lamp for keeping the oil fluid in cold weather, but I do claim the arrangement of said lamp, and its heating tubes, in combination with the above described apparatus or system of light-house lamps, substantially in the manner and for the purpose set forth in the foregoing specification."

22. For *Improvements in Leather Belts for Driving Machinery, and in the Machinery for making them;* William Kumbel, New York, April 11.

Claim.—"What I claim as my invention is the method of making leather bands by stretching the pieces separately, when this is combined with the stretching of the whole after the pieces are put together, as described. And what I claim as my own invention, in the above-described machine, is the combination of the double or single geered windlass, as described in group first, with group third; that is, the second cylinder having the retaining beam, friction pulley, and weighted lever, as described, to be operated and used substantially in the manner and for the purpose herein above set forth and described; and in combination with these the cross head and rail-way as described."

The machines used for stretching consist of windlasses and bars, with pins projecting from them to hold the punched ends of the pieces of leather intended to be riveted together to make belts. The first machine is employed to stretch the short pieces, and the second machine is of much greater length, to stretch the entire length after the pieces have been put together.

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23. For *Improvements in Machinery for Planing and Sawing Lumber;* Thomas J. Wells, New York, April 11.

The claim in this patent is limited to an improvement in the mode of feeding or moving forward the board to the saw or plane by means of reciprocating clamps, instead of feed rollers, or a carriage operated by a ratchet wheel and bands—the clamps being made to lift from the surface of the board to move back preparatory to another operation.

Claim.—"I do not intend to limit myself to means herein described of giving motion to the clamps, and I do not claim, generally, feeding saw-mills by clamps attached to slides, nor the use of the clamps for this purpose; but what I do claim as new and of my own invention, and desire to secure by letters patent, is the combination of the slides with eccentric clamps slightly pressed together, and so formed upon their faces, that, however the thickness of the stuff may vary, the line drawn as a radius from the face of the clamp at the point of contact with the stuff shall always make nearly the same angle with the face of the material and the direction of the feed.

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24. For *Improvements in the Machine for Making Bricks;* Samuel Lowery, Philadelphia, Pennsylvania, April 18.

The patentee says,—"The nature of my invention consists in making bricks on railroad cars (peculiarly constructed for that purpose) in passing or descending an inclined plane, at which time, the clay on the cars is pressed, formed, and made perfect in bricks, in such a way, that, when the cars arrive at the foot of the inclined plane, the perfect ready made brick may be received from the cars and the operation renewed."

There are two inclined plane railways on which run two sets of cars, the upper surfaces of which are properly adapted to the reception of moulds, and as these descend the inclined plane, after having been filled with clay, they pass under a roller (or rollers) which presses the clay, and then under a knife (or knives) by which the surplus clay is removed.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the mode of making bricks, in descending an inclined plane, as heretofore described, and in combination therewith I claim the rollers to press the clay into the moulds, in the manner as described herein, by one or more rollers. Also, in combination with the above, I claim the scrapers and finishing or polishing knife, for the purpose and use as mentioned above, in this mode of making bricks."

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25. For an *Improvement in the Machine for Straightening Tobacco;* George W. Macon, Louisburg, North Carolina, April 18.

This machine consists of two sets of wheels on two shafts, one above the other, the two sets of wheels running on each other with their peripheries covered with leather. The spaces between the faces of the wheels are of such size as to give the required form to the band of tobacco; and for the purpose of guiding in the leaves laterally, there is a series of small horizontal rollers on the end of hinged arms or guides, so that the rollers can be set as may be required relatively to the faces of the wheels.

Claim.—"Having thus fully described my improvements, what I claim as my invention, and desire to secure by letters patent, is a series of wheels having adjustable guiders and rollers between them, constructed, arranged, and combined in the manner and for the purpose herein set forth."

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26. For an *Improvement in the Cultivator;* Nathan Ide, Shelby, New York, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the teeth in two rows, in combination with a pair of wheels, the treads of which are in a line midway between the points of the two rows of teeth, substantially as described."

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27. For *an Improvement in the Corn Sheller;* Waldren Beach, Baltimore, Maryland, April 18.

This is for an improvement in that class of corn shellers in which the corn is shelled by driving the ear through a hole, and consists in forming the hole by a series of spring bars arranged in lines tangential to the circle of the hole thus formed, or by means of curved springs.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the elastic stripping bars in combination with the open frame, forming the apparatus or machine for shelling corn in the manner described, whether the spring bars be arranged in the manner above described, or in any other mode substantially the same."

28. For an *Improvement in the Machine for Cutting and Raking Grain;* Clinton Foster, Laporte, Indiana, April 18.

In this machine the grain is cut by a set of cutters projecting from the edge of a vibrating bar, and acting on the grain between a series of fingers, and the improvement patented consists in the peculiar manner of constructing the rake by which the grain is delivered from the platform on which it falls when cut. The platform is made with a series of grooves in which the points of the rake slide as they are operated by the vibration of a lever that receives motion from tappets on the driving wheel.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing the rake, and its connexion with the floor of said machine, as herein described."

29. For an *Improvement in the Pocket Book and Watch Safe;* Joseph Cotton, Amherst, Massachusetts, April 18.

This is simply a metallic clasp made of two plates hinged together and provided with spring, bolt, and catch, for fastening, this clasp being properly adapted and secured to the edges of a coat pocket.

Claim.—"I claim the combination of the spring, bolt, and catch, for fastening the pocket-book and watch safe, the construction and operation of which are herein above described, as my invention."

30. For an *Extension Frame for Bedsteads:* C. S. Debow, New York city, New York, April 18.

The patentee says:—"The distinguishing character of my invention is the employment of the well known series of cross levers familiarly known as "lazy tongs," placed in a horizontal position, but turned edgeways for supporting, while they can be contracted or extended at pleasure; any number of these being placed parallel, and at a sufficient distance apart, for the purpose intended, and connected by cross bars for purposes above named; when extended forming a bedstead or other supporting frame; and when contracted occupying the smallest possible space.

Claim.—"Having thus fully described my improvement, what I claim as new, and desire to secure by letters patent, is the combination of two or more series of cross levers for extension and support, arranged in the manner and for the purpose set forth, and combined with cords, webbing, or chains, which connect the butments, as above described."

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31. For *Improvements in the Magnetic Letter Printing Telegraph;* Royal E. House, New York city, New York, April 18.

The publication of an account of this patent, the specification of which runs through some twenty-five folio pages, would carry us beyond our limits, particularly as it has already been published in several newspapers.

Claim.—" What I claim as my invention, and not previously known in the above described magnetic letter telegraph, is—

"*First.* The manner in which I arrange and combine the finger keys, a key shaft, and a circuit wheel, respectively, for the purpose and substantially as herein described.

"*Second.* The combination of the escapement with the type wheel, by means of pins in the side of said type wheel corresponding in number with half the number of letters and other characters which the type wheel is constructed to form, and the above combination and arrangement of the escapement and type wheel in combination with magnets, as herein described, and for the purpose herein stated.

"*Third.* The combination of the type wheel with the lever, by means of pins fixed in the sides of said type wheel equal in number to the number of letters and other characters formed, (and by other characters I mean as well blank spot as the letters and dot,) for the purpose of regulating the motion of the shaft, to carry the paper cylinder to and from the type wheel, all as described in said specification.

"*Fourth.* The manner of combining the shaft with the lever, by means of the pin, and projections on said wheel.

"*Fifth.* The combination of the lever with the hydraulic regulator, to produce the effect herein pointed out, and in the manner herein described.

"*Sixth.* The manner of producing and regulating the several motions of the paper cylinder by the combined action of the several parts respectively, as herein described, viz: The hydraulic regulator, the wheel, the lever, the type wheel, the eccentric shaft, and the rods connected therewith, the ratchets or catches, and the posts as herein described. I also claim the manner of applying the plumbago to blacken the type, as herein described.

"*Seventh.* The combination of the composing apparatus with the magnet for the purposes specified."

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32. For an *Improvement in the Plough;* Samuel Witherow, Gettysburg, Pennsylvania, April 18.

The point of this plough (called in the claim the tongue) is let into the land side by a projecting tongue fitted to a recess which is wider at the back than the tongue, so that the back end of the tongue may be moved up or down to depress or elevate the point—the back edge of the tongue being notched as well as the back of the recess to hold the point in any desired position.

Claim.—"Having thus fully set forth the nature of the improvement, and the manner in which it is constructed, what I claim therein as my invention, is the arrangement by which the tonguec an be raised and lowered at the point, as above described."

33. For an *Improvement in the Plough;* Joshua M. C. Armsly, Worcester, Massachusetts, assigned to Ruggles, Nourse, and Mason, Boston, Massachusetts, April 18.

This is an improvement for regulating or guiding the plough, and consists of a plate attached to the forward end of the plough beam having radial teeth on its surface to receive projections or ribs from the surface of an adjustable plate, which is secured in front of the plough beam by a bolt passing through a long slot in the adjustable plate, by means of which arrangement the draught rod, that is attached to the beam at its junction with the standard, and which passes through a hole in the lower end of the adjustable plate, may be elevated or depressed, and moved to the right or left, by shifting this plate, the teeth in the other plate preventing it from turning when set.

Claim.—"What I claim as my invention, and for which I desire to secure letters patent, is the circular plate, with the cogs, teeth, or projections thereon, in combination with the guide, having ribs, spines, or projections formed on it, in the manner and for the purpose described, to prevent the lower end of the guide being moved laterally or sideways by the power of the team."

34. For *Improvements in the Pump;* David G. Colburn, Wilmington, Vermont, April 25.

This is for an improvement in the pump, by means of which the water in the barrel of the pump may be returned into the well; but as the claim refers to, and is dependent on, the drawings, we are under the necessity of omitting it.

35. For an *Improvement in the Manufacture of Spoons;* Joel Hall, 2nd, Willingford, Connecticut, April 25.

The improvement for which this patent is granted relates to the mode of holding a wire in a mould for casting spoons, so that the spoons shall be cast thereon.

Claim.—"I do not claim as my invention the enclosing a wire in the handle of a spoon. This has already been done; but I do claim as my invention and improvement, and desire to secure by letters patent, the fastening, or holding the wire, preparatory to enclosing it in the handle of a spoon, by, to, or at either side of, either part of the mould, substantially in manner and form as specified above."

36. For an *Improvement in the Machine for Cleaning, Heckling, and Dressing Flax and Hemp;* B. Langdon and Amos Salisbury, Troy, New York, April 25.

The flax or hemp is acted on by a series of knives and beaters, arranged on a rotating stock, the rows of beaters and knives alternating —the beaters are parallel with the shaft, and the knives run in the direction of the periphery. The stock, thus armed, works in a casing, near the upper part of which, there is an aperture for the feeding in of the hemp, and beyond this a roller, against which the beaters, &c., act, and at the bottom a grate.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the knives and beaters, constructed and arranged in the manner and for the purpose set forth; and, in combination therewith, we claim the arrangement of the perforated cover, the roller, and the grate, in the manner and for the purpose set forth."

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37. For an *Improvement in Curry Combs;* William Wheeler, West Poultney, Vermont, April 25.

The patentee says,—"I construct my curry combs generally of three longitudinal bars of sheet metal, united by rivets to two transverse bars, one at each end, and one at the middle of the instrument; there being open spaces formed by the junction of these bars, or plates, through which a large portion of the dust, which would otherwise lodge in the comb, escapes in the act of using it.

"The three longitudinal bars are in a trough-like form, being bent twice at right angles, by which means they are rendered perfectly unyielding. The teeth are made along the edges of these trough-like pieces, and they are sometime rounded off at their ends to remove their angular terminations; the bars constituting the comb being of one uniform length."

Claim.—"Having thus fully described the nature of my improvement in the curry comb, what I claim therein as new, and desire to secure by letters patent, is the combining of the trough-like bars which constitute the comb teeth with the other parts, in the manner set forth, so as to constitute a curry comb with an open back. I do not claim the trough-like combs, or the hollow back, individually, but only in their combination, as herein fully made known."

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38. For an *Improvement in the Water Wheel;* James Deniston, Lanier, Ohio, April 25.

This wheel consists of an inverted frustrum of a cone, to the periphery of which are attached the buckets, which project radially, and run down in a curve from the upper to the lower edge. The water is delivered on to the wheel through inclined shutes.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the cone, conical hoop, and curved floats, substantially of the form and in the manner set forth, for the purpose of forming a conical percussion water wheel. I also claim, in combination with my improved water wheel, the angle of inclination, and peculiar arrangement of the water shutes, for the purpose of producing the action of the water upon the wheel, substantially as herein set forth."

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39. For *Improvements in Machinery for the Manufacture of Hat Bodies;* Henry A. Wells, New York city, New York, April 25.

The patentee says,—"My improvements consist in feeding the fur, (called the stock,) after it has been picked, to a rotating brush between two endless belts of cloth, one above the other, the lower one horizontal and the upper one inclined, to gradually compress the fur and gripe it more effectually where it is presented to the action of the rotating brush, which, moving at a great velocity, throws in a chamber or tunnel, which is gradually changed in form towards the outlet where it assumes a shape nearly corresponding to a vertical section passing through the axis of the cone, but narrower, for the purpose of concentrating and directing the fur thrown by the brush on to the cone; this casing being provided with an aperture immediately under the brush, through which a current of air enters, in consequence of the rotation of the brush and the exhaustion of the cone, for the purpose of more effectually directing the fibres towards the cone, which is placed just in front of the delivery aperture of the chamber, or tunnel, which aperture is provided at top with a bonnet, or hood, hinged thereto, and at the bottom with a hinged flap, to regulate the deposit of the fibres on the cone, or other former, with the view to distribute the thickness of the bat wherever more is required to give additional strength. As the fibres are only held to, and on, the cone by the pressure of the surrounding air, in consequence of the exhaustion of the cone, or former, preparatory to the suspension of this pressure, some means must be adopted of holding and retaining the fibres composing the bat, and it is obvious that this delicate web, thus formed, has not sufficient tenacity to admit of removing it from the cone, or former, before the hardening process; and therefore my invention also consists in covering the bat, before it is removed from the cone, or former, with felted or fulled cloth, and then employing one or more perforated metallic cones, one to put over the bat after it has been surrounded with the moist felt or cloth, for the purpose of making pressure on the fibres, and to admit of the circulation of hot water, when the whole is immersed therein, to harden the bat preparatory to felting,—and the other, to be placed within the perforated metallic cone on which the bat has been formed, and which is necessarily thin and weak, for the purpose of resisting the pressure of the surrounding water consequent upon a partial vacuum produced within when the whole is withdrawn from the water."

Claim.—"What I claim as my invention, and desire to secure by letters patent, in the machinery above described, is the arrangement of the two feeding belts, with their planes inclined to each other, and passing around the lips, formed substantially as described, the better to present the fibres to the action of the rotary brush, as described, in combination with the rotating brush and tunnel, or chamber, which conducts the fibres to the perforated cone, or other former, placed in front of the aperture or mouth thereof, substantially as herein described.

"I claim the chamber into which the fibres are thrown by the brush, in combination with the perforated cone, or other former, placed in front of the delivery aperture thereof, for the purpose and in the manner substantially as herein described; the said chamber being provided with an aperture below and back of the brush, for the admission of a current of air to aid in throwing and directing the fibres on to the cone, or other former, as described.

"I also claim the employment of the hinged hood, to regulate the distribution of the fibres on the perforated cone, or other former, as described. And I also claim providing the lower part, or delivery aperture of the tunnel, or chamber, with a hinged flap, for the purpose of regulating the delivery of the fibres to increase the thickness of the bat where more strength is required, as herein described, in combination with the hood, as herein described.

"And, in the process, I claim the hardening of the bat whilst on the perforated cone, or former, and preparatory to its removal therefrom, by immersing it in hot water, as herein described.

"I also claim covering the bat with felted or fulled cloth before it is removed from the cone, or former, as described.

"And, finally, I claim the employment, in combination, of both of the perforated cones—one for making pressure on, and retaining, the fibres of the bat until hardened, and the other to prevent the collapse of the cone, or other former, on which the bat is formed, substantially as herein described."

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40. For an *Improvement in Mills for Grinding Grain, Paint, &c.;* Wm. Broughton, London, England, April 25; antedated July 22, 1845.

This improvement consists in giving to one of the stones a lateral reciprocating motion, instead of a rotary, as heretofore.

Claim.—"Having thus fully described the manner in which I construct my apparatus for grinding grain, drugs, colors, and other substances, what I claim therein as new is the manner, herein described, of giving to the stones, suspended in an inclined position, and capable of adjustment in their degree of inclination, a longitudinal reciprocating motion, instead of the revolving or circumlinear motion heretofore employed; the respective parts of the apparatus by which this is effected being arranged, combined, and operating substantially as herein made known."

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41. For an *Improvement in Water Wheels;* Ralph Summers, Seneca Falls, New York, April 25.

Claim.—"Having thus fully described the construction of my wheel, what I claim therein as new, and desire to secure by letters patent, is constructing the wheel so that the water shall be received upon an inclined surface, extending from the eye to the periphery, and thence entering the passage upon the same surface undiminished in width; said passage increasing in the direction of the axis, and diminishing in the direction of the radius, so that the areas of all its sections shall be substantially equal, and so located and extended that the water shall all be discharged immediately outside the periphery in a thin tangential sheet, whose plane is parallel to the axis, the whole being constructed and combined substantially as herein set forth."

42. For an *Improvement in Mail Bags;* Henry Johnson, Washington, District of Columbia, April 25.

Claim.—"Having thus fully described the nature of my improvements in mail bags, what I claim as new therein, and desire to secure by letters patent, is the manner in which I have formed and arranged the roller mouth-piece, as described. I also claim the combination of the secondary mouth-piece with the mail bag, arranged substantially as set forth. I likewise claim the use of a flexible strap, or belt, as a substitute for the chain; said strap, or belt, being made reversible, and labeled on its opposite side, by the use of which strap additional security is attained, the destination of the bag is indicated, and lightness and economy of construction are promoted."

43. For *Improvements in the Apparatus for Printing Calicoes, &c.;* Robert Ferguson & John Clark, Glasgow, Scotland, April 25, 1846; antedated September 14, 1844.

Claim.—"Having thus described the nature of our invention, and the manner of performing the same, we would have it understood that we make no claim to the applying India rubber, or Jeffery's patent marine glue to the surfaces of fabrics or materials, that process being well understood and commonly employed for various purposes; and we would have it understood that what we do claim, is the application to cylinders, or bowls, for printing machines for calicoes and other fabrics, of a smooth and elastic surface, in manner described.

"2nd. The applying an elastic bed, or surface, for block printing, as explained."

44. For *Measuring Garments preparatory to Cutting;* Henry Donges, Borough of Newport, Perry county, Pennsylvania, April 25.

This consists of a standard, to which is jointed a strap made of joint links, and on which slides a jointed sliding arm, by means of which all the measurements can be taken with accuracy.

Claim.—"What I claim, and desire to secure by letters patent, is the combination of the standard, the hinged, or jointed strap, and the jointed sliding arm."

45. For an *Improvement in Mills;* Jonah F. Ostrander, New York city, New York, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the making of the surfaces of the stones, or metallic plates, between which the material is ground, the one convex, and the other concave, the convexity and the concavity being hemispherical, or of the form of spherical segments, and giving the movable plate or stone a compound movement, consisting of the following motions, viz: an oblique gyrating motion of its axis around the axis of the fixed plate, and of a rotating motion around its own axis, substantially as described; the whole forming a mill for grinding paint, grain, &c."

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46. For a *Composition of Matter to be used as a Substitute for Type Metal, and on which Impressions can be made with Types, &c.;* Josiah Warren, Harmony township, Indiana, April 25.

As this invention gives promise of being very valuable we insert the specification entire.

"Moulds, or matrices, are made of a tough, strong clay, mixed with silex in impalpable powder in sufficient quantity to prevent cracking. These materials are made with water into a strong putty, and kneaded very thoroughly, until it has acquired all the toughness that can thus be imparted to it.

"This mixture is now softened with water till it will spread easily and smoothly upon a metallic plate; the thickness of coat varying, according to the work to be done, from the thirtieth to the tenth of an inch.

"The plates, thus coated, are allowed to become about half dry, so that a type impressed into them will leave a smooth *fac simile* of itself.

"Into this coating, forms are impressed, as hereafter described in stereotyping plates. These forms may either be an original design, or impressed by an original to obtain a copy. When the coating is required to continue moist a longer time than the above, a heavy coating, with additional silex, from a twelfth to an eighth of an inch thick, is first spread upon the plate, and, immediately afterwards, the coating first described is spread upon the under coating. It is well to spread, with a light brush, a little thin gum Arabic paste between the two coatings, but not indispensable.

"The above described matrices are used for music, maps, and similar open work; but for fine, close, or shaded work, and for writing, the coating should be of very fine clay, without any admixture of silex, more than is chemically combined to form the clay. This clay should be of such a nature as will admit of its being spread in the form of a thin mortar, to the thickness of one thirtieth of an inch, without showing any cracks in drying. Clay of this quality is found along the banks of the Ohio river, near Evansville, Indiana.

"When the coating is intended for a close *italic* handwriting, it may be spread with a tool so constructed as to leave furrows in the surface at such suitable distances as the writer may desire to have his lines; when this becomes hard enough to cut without following the tool, it may be slightly brushed over with a little olive or linseed oil. The writing is done in the furrows with any suitable tool.

"To write a copper-plate, or running hand, or for close drawings, the following is a good process: Mix a small quantity of gum Arabic paste with the mortar made of the pure clay, as above described, enough to change the color of the clay a shade darker when dry. Let this coating get quite dry, and brush it over slightly with oil. With another brush moisten each line or furrow before writing on it.

"The writing may be done in the ordinary manner, never allowing the tool used to go quite down to the foundation plate. The cast from this matrix will present a slightly uneven surface, which may be gently ground down with a hone or fine whetstone.

"The following process may be used as a substitute for the method above described:

"Spread a plate with pure clay, say one thirtieth of an inch thick, or as thick as will dry without cracking; when dry, heat it sufficiently to melt wax. Then rub over the surface a little beeswax, stearine, or tallow, and allow the plate to cool. When cold, spread on another coating of pure clay in which a little olive or linseed oil is thoroughly mixed. This should be worked on as soon as it is sufficiently dry to allow the tool to work freely.

"A great variety of clouded, wavy, or smoky effects, either as parts of a picture, or as tinted grounds, are instantly produced in a matrix by wetting the surface to a creamy softness and applying a brush, or toothed tool, with such motion as may be adapted to the design. This may be termed the *Hylegraphic process.*

"Type composition, or *silicate of lac.*

"Take one pound of good shellac, say, four ounces of good clean tar, melt together over a gentle fire, and then stir into this mixture two pounds of fine siliceous sand. When thoroughly mixed, turn out and flatten into thin sheets, say an eighth of an inch thick. When cold it may be broken up for use.

"Place the matrix over a very gentle heat, in order to expel all dampness; raise the heat a little short of the hissing, or boiling point, then lay over the matrix pieces of the silicate sufficient to cast a plate an eighth of an inch thick. Lay upon this a wooden block of the length and breadth required, and about three-fourths of an inch thick. When the silicate is sufficiently softened to take the impression, take the whole to the press. Strips of wood, or other material, should be placed upon each end of the matrix plate, as guides or bearers, so that the cast shall be exactly type *height.* This being done, bring the press gently down upon it, until the bearers stop it. When cold, remove the cast from the matrix plate, and with a brush carefully wash the face of the cast without wetting the back of the block. The face of the cast, or type, may be polished with a hone or other suitable substance. It is now ready to take a proof, and, if perfect, is ready for the press. If not perfect, mark the imperfection on the proof-sheet, to be corrected by the following process of

"*Stereotyping.*—Take a metallic plate, previously spread with the coarse under coating, say four of fine sand to one of clay, covered with a coating somewhat finer, as first described; when this is so dry as to leave a clean impression from a type, it is ready for use. Next secure the imperfect cast of the type firmly in a square frame, or printers' *chase*, with guides or bearers, as before mentioned, to prevent too deep an impression.

The plate, with the clay coatings is now turned down upon the cast, and placed under the press. The pressure is gently withdrawn, and the imprinted matrix lifted carefully from the cast, or type. (The bearers should have springs, so constructed as to lift the matrix from the type on the withdrawal of the pressure.) This gives a new matrix, in which all the necessary corrections are made, and a new cast taken, as before.

"Stereotyping may be performed by the use of any of the matrices above described, using them when the moisture is sufficiently evaporated to leave a clean impression from a type, as before mentioned. Fine engravings, or any thing of that nature, may be more beautifully stereotyped by the use of a matrix of pure soft clay mortar, spread thinly upon a flat surface of dry clay. Press the engraving into it, and allow it to remain until the whole is sufficiently dried to lift the original from the matrix.

"Coats, or types, for printing *fac similes* of leaves, or other substances, the different parts of whose surface do not vary in height more than the twelfth of an inch, may be readily made by using those substances themselves to impress their form, either in the clay matrix or in a flat surface of the silicate previously prepared to be used as a type.

"The blanks between paragraphs of written or printed matter, whether in the original or in the stereotyped matrices, should be filled up with a mixture of about six parts of fine sand to one of clay, which should be applied about the thickness of cream. The margins may be filled with the same mixture, in the form of mortar, and may be applied with a knife or spatula."

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47. For a *Machine for Drying Sized Paper;* Joshua Norton, Jr., Boston, Massachusetts, April 25.

A sheet of paper of any length can be dried in this machine after having been sized, by being first acted upon by a fan as it passes down an inclined plane composed of a series of small rollers, at the lower end of which, it passes around a large hollow cylinder heated with steam; then it runs back over a horizontal plane made in the same manner, then over a small roller, around a second large hollow cylinder heated by steam to a higher temperature than the first, and finally, around a third cylinder heated to a higher temperature than the other two. The paper is carried around nearly three-fourths of the circumference of the second and third cylinders, by passing around small rollers on each side of them.

Claim.—"I do not intend claiming the principle of drying sized paper by the application of heat by steam, but what I do claim as my invention, and desire to secure by letters patent, is the principle of gradually drying sized paper of any length by means of the fan and the hollow cylinders, heated by steam to different degrees of temperature, in the manner and for the purpose herein described."

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48. For a *Machine for Making Bricks of Clay in the Dry or Natural State;* John Simpson, Decatur, Georgia, April 25.

Claim.—"Having fully described my improved brick machine, what I claim therein as new, and desire to secure by letters patent, is the compressing dry clay, or clay in its natural state, into moulds, by the percussion of heavy beaters, combined and operating with the other parts of my machine, substantially in the manner set forth."

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49. For *Improvements in Ploughs;* Harvey H. May, Galesburg, Illinois, April 25.

The patentee says,—"The nature of my invention consists in making a lip or projection on the land-side, fitted between the share and point of plough post or standard, to prevent the share from cleaving or separating from the land-side; in inclining the plough post to the right from the land-side, and passing to the right side of the beam for a right-hand plough, and to the left for a left-hand plough, having the top or upper end of the post formed in an angle, or elbow, to project across the top of the beam; and in giving to the mould-board a conical form, making the plough draw easy and do the work with great perfection."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is extending the standard, or post of the plough, above and topping over the beam, for the purpose and in the manner herein described."

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50. *For a Core-box for making Sand Cores;* Henry Kellogg, assignee of Isaac Kellogg, New Hartford, Connecticut, April 25.

The patentee says,—"The nature of my invention consists in joining the two parts of the core-box together by a hinged joint, or any of the usual devices which will insure their exact meeting together, and then forming the parts into blunt cutting edges at the line where they meet together, and partially closing, and in that position filling the box with loose moulding sand, and then closing the box, to compress the sand."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is for an improved core-box for making sand cores for castings, having its parts well guided in opening and closing, and having cutting edges at their lines of meeting, so that no sand can be retained between them to prevent their closing exactly, and fitted to be placed partly open when loosely filled with tempered sand, which is suitably compressed by closing the core box, and the surplus sand at the same time pared off and thrown out by the edges, and thus making the core uniformly solid, or hard, in all its parts, and of so exact a form that the hole made thereby in the casting will, in many cases, need no 'reaming;' thus making better cores, and with greater despatch, than have usually been made by 'reaming up,' so termed, by moulders and founders."

51. For an *Improvement in the Hay Press;* Daniel R. Allen, Cumberland, Maine, April 25.

This patent is granted for an arrangement of levers by which the follower of the press is forced up, and consists in connecting the short arm of a lever with a second lever, this connexion becoming the fulcrum of the second lever, the short arm of which is jointed to the follower of the press, and its long arm provided with a pulley, as also the long arm of the two, so that, by means of a rope or chain passing around them, the two can be drawn together, and thus force up the follower.

Claim.—"I am cognizant of the fact that toggles have been constructed, wherein one was a long lever, jointed between its ends to one end of a short arm, constituting the other toggle, and which turned upon a pin, or fulcrum, at its opposite end; the power which operated the said toggles being applied to but one end of them, viz: the long lever. I do not claim such; but that which I do claim, is the extended levers, as made and combined together, and having the power which operates them applied to both of them, and operating upon them as above described."

52. For a *Machine for Rolling Tobacco;* Wm. P. Marston, Danville, Virginia, April 25.

Claim.—"What I claim, and desire to secure by letters patent, is the arrangement of a series of rollers in a circle in a hinge or folding frame, with proper gearing to give them all a similar motion, in combination with a feeding apparatus, as described; the whole being constructed, combined, and operating substantially as set forth."

53. For a *Machine for making Hommony;* Wm. Y. Singleton, Springfield, Illinois, April 25.

The corn is crushed by a wheel that travels around in a circular trough. The shaft which carries around the crushing wheel also carries the elevators, sieves, &c., for removing and screening the corn as it is broken.

We have to omit the claim, as it refers to the drawing, and could not be understood without it.

54. For an *Improvement in the Ventilator, for the tops of Chimneys;* Michael Collins, Boston, Massachusetts, April 25.

In this case we are also under the necessity of omitting the claim, because of its reference to, and dependence on, the drawings.

Additional Improvements.

1. For a *Furnace for Burning Bricks;* Joel W. Andrews, Norristown, Pennsylvania, April 4, 1846; added to original patent, bearing date March 21, 1843.

Claim.—"Having thus fully set forth the manner in which I construct and use my kiln for burning bricks with anthracite or other coals, what I claim as new, and desire to secure by letters patent, is the two principal flues passing outside of the kiln, one on each side, and one centre flue, passing through the centre and under the floor of my kiln. These main flues are connected with lateral flues, or branches, (as described in my original patent,) necessary to conduct the wind required under each fire or into each air chamber. I have, in the foregoing description, given that form and arrangement of the respective parts which I deem the most convenient, but without intending thereby to claim any thing claimed and covered in said letters patent granted the day and year within mentioned, No. 3,016; also without intending thereby to limit myself in these particulars, but varying the same as I may find expedient, whilst I attain the same end by means substantially the same, in the manner represented and made known."

FRANKLIN INSTITUTE.

Committee on Science and the Arts.

Explosion of the Locomotive Engine "Neversink," upon the Reading Railroad.

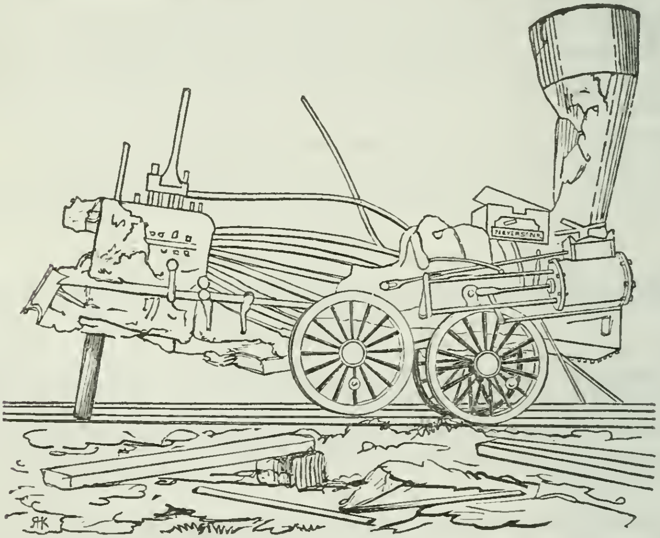
The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred the examination into the causes of the explosion of the locomotive engine "Neversink," upon the Reading railroad, on the evening of the 14th January last, Report:—

That they have collected all the evidence bearing upon the subject which they could obtain, and have visited Reading for the purpose of examining the wreck of the engine; and they desire in this place to return their acknowledgments to the officers of the Reading Railroad Company, and especially to Mr. G. A. Nicolls, the Superintendent, for their very great courtesy and kindness to the committee, in facilitating, in every possible manner, their examinations, and putting them in possession of all information having a bearing, upon the object of their research. The following is the result of their inquiries:—

The engine Neversink was originally built by Baldwin, and sent upon the road in April, 1836. It then weighed 10½ tons, and had six wheels, two of which were drivers. The engine was thoroughly renewed and rebuilt by the Reading Railroad Company at their Reading depot, in April, 1846, and was changed to an engine of 19 tons, on six wheels, all connected drivers.

In rebuilding it, four plates in length at the fire-box end of the cylindrical part of the boiler were retained, and 1½ sheets in length were added at the front end of the boiler. The new iron was five-sixteenths of an inch in thickness, the old one-fourth of an inch.

The vertical part of the boiler was 51 inches in diameter; the fire-box was 39 inches long, 37 inches wide, and 44 inches high; the crown was stayed with wrought iron bridge bars, and was so strong that it received no damage from the explosion. The horizontal portion of the boiler was 41½ inches in diameter, and 11 feet six inches in length between the tube-sheets. The smoke-box was two feet three inches in depth; making a total length of boiler of 18 feet. There were 128 wrought iron tubes, two inches in internal diameter and one-eighth of an inch thick in the wall; they had copper ends at the fire-box tube sheets.



There was but one safety-valve, 2½ inches in diameter, placed upon the dome; there were four gauge-cocks, the lower one of which was eight inches above the crown-sheet, and the upper one about 14 inches above the lower.

The highest tube was 1½ inches below the crown of the fire-box, and 11½ inches below the top of the cylindrical part of the boiler.

The fire surface, reduced to fire-box surface, amounted to 309 square feet.

The cylinders were 13½ inches by 20. The driving wheels 46 inches in diameter.

It was a favorite engine upon the road, and had run, previous to alteration, in April, 1846, . . .	71,010 miles.
Afterwards, ...	18,041 "
Total,	89,051 miles.

Upon their examination, the committee found the horizontal part of the boiler almost completely destroyed. In this part of the boiler the explosion had manifestly originated, commencing in the older iron which remained in the hinder part of the boiler. The tubes were, for the most part, still fast in the tube-sheets, but they were bent outwards at their middle, like the staves of a barrel. The steam pipe, as it passed through the boiler, was *collapsed*, but not broken. The outer shell of the boiler had been torn into fragments, and the rents had extended to the vertical part, the upper portion of which had been entirely torn away, so as to expose the fire-box, which was sound, but slightly caved in on the sides. The cylinders were unharmed by the explosion, but had since been removed. The quality of the iron appeared to the committee to be uniformly good.

There was, therefore, nothing about the engine to indicate that the accident had occurred from defects in workmanship or material, nor, indeed, did the tremendous power which was indicated, seem consistent with the idea of an originally defective boiler.

Through the kindness of Mr. Nicolls, the committee had an opportunity of examining Patrick Fagan, the engine driver usually in charge of the Neversink, whose testimony is in substance as follows, viz:—

That, when in the hands of a driver who understood it, the Neversink was the best engine he ever knew, but that no one who did not understand the engine, could tell, by the gauge-cocks, how much water there was in the boiler; that it would frequently throw water out of the safety-valve when the water-level was, in reality, below the second gauge; that the pumps were good, and had never given trouble when the water-level was kept up, and could always be made to act by opening the fire doors and cooling the fire down, but that when the water is low, and the engine hot, no pump will act; he "has worked the engine when, with both pumps on, he could not get the water up for an hour, but could always do so by running slow, and cooling the engine." Has carried 150 lbs. steam upon the engine, (the steam was then damp,) but believes that any engine is dangerous at that pressure, "as at that heat, a second will throw the water out." The pumps delivered the water into the boiler about six inches behind the smoke-box, and about half way up the tubes; the receiving valve was under the cylinder; the check valve between the cylinder and boiler, and the discharging valve close up to the boiler: the distance from the receiving to the check valve was about four or five inches, and about 20 or 24 inches from the check to the discharging valve. The engine was at this time in perfect order; had been brought down by the witness on the preceding Tuesday, and had laid over until Thursday night, when the witness went to the depot for the purpose of taking it up again, but was recalled by a message from his sick wife, and the engine was entrusted to Jacob Salleburger, under whose charge it was when it exploded.

In reference to the behavior of the engine, Mr. Kirk, the foreman of the shops of the Company at Reading, remarks, that he was not aware of any peculiar difficulty about the Neversink, but that "all our large class engines are a little ticklish in carrying water." The cause of this we shall presently endeavor to shew.

The accident occured about 30 yards above Mill Creek bridge, and the watchman upon the bridge gives the following account of what he saw and heard:

He was standing in front of his door when he heard the engine coming, and, as it approached, he noticed the peculiar loudness and sharpness of the exhaust; the engine was then running very fast, and was not blowing off steam. As it passed the bridge, one of the persons upon the platform was stooping down, apparently looking in at the fire doors, and as he rose, he put his hand either upon the safety-valve or upon one of the stays; almost immediately afterwards, the witness heard a very loud roaring like thunder, which he is sure was not the escape of steam from the safety-valve; this lasted about 30 seconds, when the explosion took place, by which he was knocked down, and saw no more; when he got up he ran immediately to the engine, but was so engaged attending to the sufferers, that he paid no attention to the appearance of the engine.

Mr. Nicolls, Mr. Kirk, and Mr. Fagan, all testify that, when they saw the engine next morning, the broken ends of the tubes, as far down as the fourth row from the top, were blue from the effects of overheating; a member of the committee, however, who was on the ground at the same time, declares that he could not perceive this, though he looked for it, particularly; when the committee saw the engine, at Reading, no such appearance was visible, nor could it be expected, since a snow fell on the night of the accident, and subsequent oxidation would destroy all traces of the color.

Neither did the fire-box give any observable indications of an exposure to an unusual heat. Yet there is no doubt in the minds of the committee that the want of a proper supply of water was the proximate cause of the accident.

The evaporative power of these heavy engines is necessarily very great. Mr. Nicolls assured the committee that the Neversink was capable of drawing a train of 88 cars, weighing, loaded, 7½ tons each, (equal to 637 tons,) at a speed of 12 miles per hour. (1056 feet per minute.) Allowing the traction to be 7½ pounds per ton, (as experiments upon this road shew it to be,) this is equivalent to 153 horse power —requiring an evaporation of 2·55 cubic feet of water per minute.

Now, by the peculiar construction of these engines, rendered necessary by the restricted space allowable for the boiler, when the water-level stood two inches above the lower cock, the steam was confined exclusively to the hemispherical dome above the fire-box, the cubic content of which is rather less than 24 cubic feet. (23·8565 cubic feet.) The cubic content of each cylinder ($13{\cdot}5 \times 20$) is 1·657 ($1\frac{5}{8}$) cubic feet, and, as two cylinders are drawn at once, the ratio of the cylindrical content is as 3·314 to 24, or more than one-eighth. When the water-level is at the upper gauge-cock, the steam room is nine cubic feet, and the ratio about one-third. Now, the most recent (and apparently the best) authority upon the high pressure engine declares, after nearly 30 years of practical experience, that "the steam space should be at a minimum 20 times as great as the space to be filled with steam in the cylinder. If it can be made greater, consistently with the other arrangements of the boiler, so much the better."* This is, of course, inapplicable in locomotive engines.

The reason, therefore, that these engines will throw water from the safety-valve, and from the gauge-cocks, when the actual water-level is dangerously low—and that, in the words of Mr. Kirk, they are ticklish in carrying their water, must be evident. The foaming in one of these engines must be incessant, and the danger of priming very great. The gauge-cocks, which, under the most favorable circumstances, are but indifferent indicators of the water-level, become, in this case, useless, and the engine driver must rely upon his experience of the engine and trust to incessant watchfulness alone, if he would avoid an accident.

A very remarkable fact about this explosion is, that the steam pipe passing through the upper part of the boiler, from the throttle valve to the cylinders, was *collapsed* and unbroken, as is well seen in the accompanying Daguerreotype portrait of the engine, taken after the explosion by Mr. David Monday, of Reading, and kindly lent by him to the committee. It is, indeed, possible that this may have been produced, during the explosion, by the sudden bending upwards of the tube, otherwise it would seem to indicate that the engine was throttled at the time of the explosion; an expedient which may have been resorted to for the purpose of avoiding the dampness of the steam, or to check the speed of the engine; but the fearful danger of which will be seen when it is considered that, if the steam was shut off but one-fourth, (the water being above the lower gauge-cock,) the pressure in the boiler would double itself in about one minute.

It seems useless to speculate upon the immediate cause of this terrible accident, since the death of all upon the engine has removed the direct testimony of the circumstances under which it occurred, except that of the watchman before referred to. From his evidence, however, it appears that the engine was under a very unusually heavy pressure of steam, and scarcely less certain that the safety valve was (accidentally or otherwise) fastened down.† Mr. Nicolls and Mr. Kirk both testify to the competency of the engine driver, who was in charge, and every one bears witness to his character for sobriety. That he may have been deceived as to the height of water in the boiler is possible from the character of the engine, although it is difficult to imagine how an experienced hand could have neglected the indications given by the increased pressure, as shewn by the rapid running of the train and the sharpness of the exhaust.

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* Alban, on the high pressure steam engine, p. 90.

† After having his attention repeatedly called to the importance of this part of his testimony, he still confidently asserted that no steam was escaping from the valve at the time the engine passed him.

Dr. Alban, in his recent treatise upon the high pressure engine, before referred to, mentions a rumbling noise as often preceding explosions, and attributes it to the sudden loosening of the scale upon the boiler, and the increased access of water to unduly heated metal thus produced; (p. 18.) But the scale upon the tubes of the Neversink was not thick enough to produce any effect of this kind, nor does it appear to have been loosened to any extent. It seems, therefore, more probable to the committee that the roaring noise referred to by the watchman as preceding the explosion, may have been caused by the starting of one or more of the tubes at the forward end, and the consequent escape of the steam into the smoke-box, the sudden diminution of pressure consequent upon which, would cause the rise of water in foam over the heated tubes, and thus almost instantaneously produce a pressure which no locomotive boiler could withstand.*

Upon the whole then, it appears probable to the committee that the explosion of the Neversink occurred in this way:—

That the engine was running under a heavy pressure of steam, and that, owing to the defective indications of the gauge-cocks, the water in the boilers was permitted to get below the upper tubes, which thus became unduly heated; that the rapidly increasing pressure (assisted, perhaps, by an injudicious partial closing of the throttle valve) caused the starting of one or more of the tubes from the forward tube-sheet, and this sudden relief of the pressure caused a foaming in the boiler, by which the water was thrown over the heated tubes, and being thus rapidly evaporated, caused an instantaneous increase of tension, which the additional openings were incompetent to relieve, and thus produced the rupture of the outer shell of the boiler. This, however, is intended only as a plausible suggestion, and by no means as a confident affirmation of the cause of the explosion.

But whatever hypothesis may be adopted to explain this unfortunate accident, its investigation has forcibly called the attention of the committee to several matters which they believe to be of sufficient practical importance to deserve the attention of the Institute.

First. The necessity of providing all steam engines with a second safety-valve, of large dimensions, regulated to the maximum pressure which the engine is intended to bear, and placed beyond the control of the engine-man. It is true that this will entail upon the owners the trouble of frequent examination to maintain the efficiency of such

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* The boiler of the Neversink being of wrought iron, one-fourth of an inch thick, (at minimum,) and 41½ inches in diameter, would, according to Oliver Evans' rule, (Young Steam Engineers' Guide, p. 23,) sustain a pressure of 51·4 atmos.

The formula is $p = \frac{2\,s\,t}{d}$:

Where p = the bursting pressure s = a constant depending upon the tenacity of iron, =, according to Evans, 6400. t = thickness of iron in tenths of an inch. d = diameter, in inches.

$$\frac{12800 \times 2\cdot5}{41\cdot5} = 771 \text{ lbs.} = 51\cdot4 \text{ atmospheres.}$$

a valve, but this trouble will be more than compensated by the increased safety which will be procured by its use.

Secondly. The uncertainty of the ordinary gauge-cocks, as indicators of the water-level under the most favorable circumstances, and the deceptive character of their indications upon the modern locomotive engines, where the amount of work to be done and the restricted space which can be allowed to the boiler, necessarily confines the water and steam room, and renders the evaporation more tumultuous than in the larger boilers of stationary engines.

The incompetency of the gauge cocks to indicate the true water-level, especially under high pressures, is admitted by most writers upon the steam engine, (Pole, on the Cornish engine, pp. 61, 108, note; Alban, on the high pressure steam engine, p. 111,) and is noticed in the report of the Franklin Institute Committee on Explosions, (Journal, vols. xvii., p. 8, et seq.; xviii., p. 295,) who recommend the glass tube water-gauge, in which recommendation the present committee cordially join, believing that there are no objections to its use which cannot be easily overcome.

The committee have also seen in operation a new and simple instrument for indicating the true water-level, patented by Messrs. Worthington & Baker, and described at large in the Farmer and Mechanic, March 4th, 1847. How far this may be applicable to the locomotive engine, practical experience alone can determine; but the committee recommend it to the notice of locomotive builders. It may be seen upon the boiler at the works of Messrs. Merrick and Towne.

Thirdly. The committee would suggest the inquiry whether it is not feasible and advisable so to construct the locomotive engine that explosions, if they occur at all, shall take place in such a manner as to be less destructive to human life than they at present are. One of the great recommendations of the tubular boiler, when first introduced into use, was this very diminished liability to do injury, by allowing a tubular flue, of comparatively small size, to collapse, in place of the large cylinders, by which the boiler was at once emptied of its contents.

The perfect condition of the fire-box of the Neversink showed the committee how well the Superintendent of the Reading Railroad has guarded against the determining cause of the explosion of the Richmond, and the committee would earnestly recommend to him, and the ingenious mechanics with whom he has surrounded himself, as well as to our locomotive builders generally, to devote their attention to this matter of contriving some means by which the accidental explosions of these indispensable but dangerous machines may be rendered less destructive to those who are in charge of them.

By order of the Committee,

William Hamilton, Actuary.

Philadelphia, March 11, 1847.

Remarks respecting the Copper District of Lake Superior, made at the Monthly Meeting of the Franklin Institute, March 18*th*, 1847. *By* Dr. William Pettit.

The subject of mining for copper has been interesting the public mind for several years.

The scene of the chief mining adventure in search of this metal is in the vicinity of Lake Superior, in a border territory assigned by the United States to the State of Michigan in the settlement of the Toledo war question with Ohio.

The first government surveys of that region of country took place during the summer of 1845, whilst I was residing there. The survey was conducted by the late lamented Dr. Houghton, who, with a lineal sectional survey for the United States, combined a strict geological examination, and barometrical admeasurement of altitudes, attended with great labor, for the benefit of science alone. He penetrated the forests, and coasted the waters of the great lake in his frail shallop many thousands of miles, in the pursuit of his interesting object; manifesting an untiring industry, and encountering hardships that have seldom been equalled. Unfortunately, in the midst of his work, he fell a victim to undue temerity in attempting a night transit, in his little boat, in the face of an impending storm.

The treaty with the Chippewa Indians had been concluded in 1842, for this territory. And about the same time attention was directed thither, with a view of exploring the country for copper. Accordingly, in 1843, the Secretary of War granted certain "permits" to individuals, or companies, to examine certain tracts therein specified; and, if discoveries should render it desirable, the "permittees" were to have "leases," respectively, for the tracts permitted to be explored. The "leases" were to run three years, and were renewable three times. The term of tenure, therefore, was one year for the "permit," and nine years for the "leases," in all ten years. Pre-emption was *expected* to follow. Accordingly an Act of Congress was passed at the late session to sell to occupants, at $2·50 per acre, the extent of their "permitted" tracts. Other lands to the highest bidder; provided, the minimum price shall be $5·00 per acre.

The mineral land district was defined to extend westward, from Chocolate river on the east, to the Apostles' islands. Under the present law of Congress, however, I suppose that it will include the entire addition to the State of Michigan, from St. Mary's river on the east, some three hundred miles westward, to the State line, at the Montreal and Menominee rivers.

I can, on this occasion, speak only of the promontory called "Point Ke*w*enaw," (or "Kew*a*wenon,") which, from its base at the main land, across from Lé Anse (bay) to Elm river, extends some seventy miles northward, into the lake, terminating in what is called "the Point;" (of Point Kew*a*wenon.) A narrow strait occurs here, and Manitou island completes the rocky extension. A glance at the map (plate iii.) will illustrate my description.

A large portion of Kew*a*wenon point is nearly separated from the main land by "Portage lake." A narrow isthmus, however, unites them. The path across this isthmus, three-fourths of a mile, is called the "Portage." The Indian and French voyageurs not unfrequently shoulder their bark canoes and carry them across, in going and returning, in their annual visits to La Pointe, from Saut de Ste Marie and Lé Anse. La Pointe, on Madaline island, (one of the Apostles' group,) is the place of paying the annuity. The "payment" is the scene of a great gathering of Indians, half breeds, and traders.

On this almost island point (Kew*a*wenon) I resided with my family from the 4th month, (April,) 1845, until the 6th month, (June,) 1846. The climate is exceedingly salubrious and restorative to invalids. I know of no spot on the globe to which I would sooner recommend the impaired constitution to go with prospect of relief. Not only for a few weeks, or months, would it be profitable; but, in chronic cases, even a year, or more, spent in the bracing climate of Point Kew*a*wenon, in Lake Superior, would be a safe course. Of the seventy persons under my charge during the time that I resided there, one was seldom heard to cough. The sickly recruited and the feeble grew strong.

In a word, let me say to invalids and the wearied with city life, that a period of six weeks, or two months, spent in making the trip and residing there, is, in my estimation, worth a dozen Cape May or Nahant visits.

Point Kew*a*wenon being nearly surrounded by water may, perhaps, be the cause of the favorable temperature. The depth of lake Superior is such as to prevent its closing with ice, and the warmer water rising from beneath to the surface, and giving out a portion of its caloric, tends to preserve a uniform mild atmosphere in winter, with rare exceptions of a few days at a time; when a continuous norther of great severity reduces the mercury to zero. On one occasion, it fell to 6 or 8 degrees below, for a few hours. The average temperature of the 1st month, (January,) 1846, was about 20° Fahrenheit. It was sometimes as moderate as 40°. This, I believe, in latitude 47½ N., is remarkable for the western hemisphere. A depth of from 16 to 20 feet of snow fell during the five months of winter, but (as the earth never freezes) it seldom attained a depth of more than from three to five feet. It is also worthy of remark that it seldom rains there in winter.

It will be proper to introduce the subject of copper mining with stating some of the prominent features of the rock formation on Point Kew*a*wenon as it strikes the eye; with little pretension, by the way, to geological technicalities. This deficiency, however, is the less to be regretted, as it is your good fortune to be able to command, I doubt not, if you desire it, in a scientific and satisfactory way, the history of this interesting section of country, from the lips, or the pen, of your own able State geologist, Professor Rogers, whom I had the happiness to meet in the Lake Superior mineral district.

Three leading divisions of the surface formation may be noticed. *First,* The highest mountain ranges, varying from one to three miles from the coast, are of "trap" rock: compact greenstone at the summits; and amygdaloidal, or cellular, at greater depths from the mountain tops. This may be denominated the "primitive rock," and the only reliable matrix for metals. *Second,* The (old red) sandstone, lapping on to the declivities of the primitive trap range. The veins of spar (carbonate of lime, and quartz, sometimes laumonite, datholite, or analcyme) which usually accompany the "lodes" of metal, strike feebly through these sandstone strata, and afford no reliance for a workable "lode" of metal. The outcrop of this division is usually narrow. It preserves the same dip, of course, as the sides of the trap uplift, upon which it rests. *Third,* The "conglomerate" rock, (or *pudding stone.)* This is a sedimentary rock, formed of pebbles and larger boulders, evidently rounded by attrition upon one another from the action of water; in which element they have once been carried back and forth upon the bottom of the deep. These pebbles are of every variety of rock, and are now firmly cemented together with lime and the sand-like *debris* of former rocks. These boulders will generally, in breaking the conglomerate, part in twain, rather than at the line of union.

Mountains many hundred feet high are found on the Point, of this material; and it, too, preserves a regular dip—often overlying the "mother trap," or primitive rock, of which I have spoken. Sometimes the sandstone intervenes, as before adverted to. The outcrop of this formation along shore is very extensive. It is exceedingly hard, and difficult to quarry. The layers of conglomerate, of old red sandstone, and the "dykes" of trap and altered sandstone frequently alternate; but when we reach the main trap range, this primitive material prevails, and alternation ceases. The veins of spar are exceedingly bold and well defined in the conglomerate, and carry large masses of metal occasionally, both in the native state and in the ores; but the lodes in this material have, thus far, proved only "bunchy" and uncertain.

As the primitive formation, though occasionally granite, is, for the most part, "trap,"—so called from the *steppes* of the Alps, it having a step-like surface fracture at the outcrop—it may be proper to say a few words descriptive of it.

Trap rock is apparently a *lava* production; the result of volcanic fusion of different sorts of minerals into one mass. By the presence of water, perhaps, during the hot state, singular crystallizations occur throughout.

While on the subject, we may properly consider this species of rock under two heads, viz: the "greenstone" trap, which is compact; showing fewer marks of the action of water while cooling. This description of stone forms the *super*structure of the trap range, and varies from a few feet to one hundred feet, or more, in depth. And, secondly, "amygdaloidal" trap, which forms the *sub*-structure of these mountains, is of an open texture, abounding in cells; some empty, others filled with different substances. It happens, in the same piece of this description of rock, that we find some of the cells filled with a soft green substance called "chlorit;" others, with agate or carnelian; and others again, with copper or silver. The almond shape of these cavities, and of the substances filling them, gives name to the rock, *(amygdaloid.)*

From the abrasion of the rocky shore, these almond shape nodules of hard material, that formerly filled the cells, are picked up in abundance by visiters,—the softer substance of the rock having been pulverized to sand.

There is, on the coast, some 18 miles west of the extreme point, a harbor, where agate and carnelian, a few years since, were so plentiful, from this destruction of the cellular rock by abrasion, that it obtained the name of Agate harbor. This harbor became the scene of fashionable excursions for the officers and ladies of the garrison, nine miles below:—(Fort Wilkins, a military post, erected at Copper harbor in 1844–5.) They would go up in their open Mackinac boats, spend a day in gathering these crystalline gems along the beach, and, if overtaken by stormy weather, they were prepared to encamp out in tents until the return of a calm sea. I had an agreeable visit of the kind, with the gentlemanly commandant, Capt. Clary, and suite, in the spring of 1845.

Smoothly polished lumps, or boulders, of metal, have also been picked up frequently on the coast of Lake Superior: and, indeed, to the frequency of finding native metal along the shore, may be traced the origin, in part, of the present mining movement there. The finding, on the Ontanagon river, a boulder of native copper weighing 3700 pounds, and transferring it to Washington city, in 1843, likewise led to inquiry concerning that country; but, perhaps, more than all, the celebrated "green rock" of "voyageurs," (as the French and Indian boatmen are called,) which stood out of the water several feet at the lower entrance to Copper harbor, attracting the attention of the scientific, became the subject of analyses, and proved to be silicious oxide and carbonate of copper, rich in metal.

While tracing back towards the mountain the marks of the vein (or "lode") of calcareous spar, in which this green rock showed itself, a rich deposit of the black oxide of copper was found (by accident) near the garrison buildings at Fort Wilkins, which, upon survey, proved to be a continuation of the same "lode," though three-fourths of a mile further inland, from the site of the green rock in the margin of the lake.

Forty thousand pounds of this ore were shipped to Bostón and yielded about 67 per cent. of pure metal. Nearly thirty thousand pounds of the ore of less value were mined at the same time.

This lode was found and worked in the conglomerate rock, and could not be relied on for regularity of yield, until we should penetrate the primitive formation below. Shafts were sunk, and the depth of 125 feet attained, but no signs of reaching the trap basin, in which this conglomerate sediment rested, having appeared, and the necessity occurring of erecting expensive pumping and hoisting apparatus, if prosecuted further, the Company were induced to retreat for further explorations to the range of trap hills from two to three miles from the coast.

In this formation, discoveries of a more satisfactory nature were soon made: especially on a leased tract ("No. 5" at U. S. Ord. Office) about 25 miles further westward, the somewhat noted "Cliff mine" was found.

The specimens which are before you as well as many others that may be seen by the curious in these matters at my rooms, 188 Chesnut street, are from various mines, many miles apart, and mostly situated in the trap range spoken of.

The Cliff mine presents the extraordinary phenomenon of having produced a single mass of copper of, perhaps, 80 per cent. value, 50 feet in length, six feet deep, and an estimated average of six inches in thickness! How much larger the continuous piece of copper was is not known, as, after drifting along side of it into the Cliff mountain, it was chiefly cut away in parcels, and removed by cold chisels, wedges, sledges, and blasting; until, at length, being reduced to such dimensions, that the pieces were removable from the drift by the attachment of tackles and oxen. This was taken from the mine since the close of navigation last fall.

It is reckoned, besides the numerous masses of nearly pure metal that have from time to time been found in this mine, that several thousand tons of rock, containing from 6 to 25 per cent. of copper, are already mined at the Cliff mine, and ready for machinery to separate the metal.

Machinery for separating the metal from the rock, together with the necessary steam power, was sent out last fall, and has been in process of erection during the present winter. Operations therewith were to be commenced by the 15th ultimo.

One hundred men are employed already at the Cliff mine, and if no unforeseen mishap occur, way will soon be opened for several hundred more.

The peculiar situation of this lode renders it practicable to drain the mine for some 240 feet in depth, and an expensive adit, or drain, is already cut from the level, 240 feet from the top of the mountain, out through the rock and earth to the west branch of Eagle river, which drains the valley.

A trial shaft has been sunk in the rock 60 feet below the adit level, say, in all, 300 feet from the top, and the quality and quantity of metal in the lode does not at all diminish.

The lode is not horizontal, as most Pennsylvania coal and iron ore veins are, but vertical. So are most, or all, the veins, or lodes, found on Lake Superior, and the direction N. 28° E., is nearly at right angles with the strata of rocks and with the mountain ranges of primitive trap formation. The Cliff lode varies from five feet wide to two feet, and in some places extending to a much greater width, carrying metal, and 4 to 18 inches of this very rich metal.

On the same leasehold, (No. 5,) several other lodes have been discovered. I saw a lump or mass of copper, nearly pure, quarried from one of the new diggings, weighing about 200 pounds; and from another opening, a piece was taken of some 40 pounds. But neither of the new "prospects" compares favorably with the main Cliff mine.

A number of remarkable shots of pure silver have been struck in working the Cliff lode, varying from several pounds to slight traces, and more or less silver occurs throughout the product of this mine;

animating the adventurers with the probability that, while they continue to work for the copper, a rich deposit of silver, of great value, *may* yet be found.

Three miles from the Cliff location, in descending Eagle river, on lease No. 2, many points of silver have been found with the copper, and a singular boulder of silver, quite pure, weighing seven pounds, was mined there. This beautiful specimen fell under my own observation.

They have erected machinery, propelled by water, at this place, to separate the metal from the rock.

Opposite Sand bay, at the Copper Falls mine, I descended a shaft some 40 feet, to examine a mass of copper found in the lode. I should, from the measurement made when I saw it, say that 8 to 10 tons were uncovered, and the full extent was not then ascertained. A considerable sprinkling of silver was found with the copper at this mine also.

At Eagle harbor, 12 miles eastward from the Cliff, a large mass of copper in a lode of laumonite spar was in process of excavation when I left. This discovery, like the one at Copper harbor, occurred in an unfavorable formation. It was, here, of a trappean character; but only a narrow outcrop, showing it to be but a dyke of trap, shot up between strata of conglomerate and altered sand stone, and giving slight hope of permanence.

By tracing the lode back, however, to the mountain, the discovery may, it is hoped, be renewed in the primitive range of mother trap.

At Grand Marais, and at Lac Labelle and vicinity, interesting discoveries have been made. Also at the North-west and Suffolk mines.

At Agate harbor, and the diggings between that point and Copper harbor, promising mines were found of sulphuret and native copper. A single piece was sent to Boston from lease No. 15, weighing about 700 pounds, which now lies in the Exchange there. But these mines were found in conglomerate rock also, and, of course, little confidence could be placed in their durability, unless machinery, at great expense, were provided, to enable the adventurers to pierce the primitive rock below at an unknown and, perhaps, a great depth.

On the *southern* border of lease No. 4, (at Copper harbor,) 2½ miles from the coast, an exploring party, after abandoning the lode at the fort, have discovered, in the lofty trap hills, what is reported a good workable lode.

Also, still nearer the extremity of Point Kew*a*wenon, other lodes are reported to have been recently found, on different tracts, by the respective companies who are exploring them.

On Torch lake, (a branch of Portage lake,) 15 miles westward from the Cliff mine, and at several points between the Cliff and Torch lake, discoveries have been made: at the North American, adjacent to the Cliff; at the Albion and Trap rock river locations, in particular, well defined lodes, carrying metal, have been discovered, and will doubtless be worked.

I may, before leaving the subject, advert to the new movements making further west, on Elm river; on the Ontanagon river; in the Porcupine mountains; and also on Isle Royale. It is said that several good mines are about being opened; and the Ontanagon district, in particular, is named as promising well to the adventurers. I did not visit these western localities.

It is, perhaps, known, that the British government have become imbued with the Lake Superior copper spirit, and, desiring to have the north coast explored, numerous grants have already issued from the crown, confering 21 years permits, to that end.

I have a letter from an intelligent gentleman who was engaged to inspect some localities on the Canada side. He reports favorably.

I have no doubt but that there will be an abundant supply of this useful metal produced, in process of time, for the greatly enlarging demands of the American people, out of our own mountains.

Already, during the course of test experiments in Boston, there has been produced, of the Cliff mine product, a superior article of sheathing copper; and a fine vessel has gone to sea coppered with Lake Superior metal.

The quantity of silver, inseparable, by any profitable process, in each ton of the copper, is about equal to from $50 to $60 value. It is hoped and believed, by the scientific, that the increased resistance to corrosion by the presence of this amount of silver, will be found to enhance the value of the sheathing in proportion.

It may be rendering some service to those who may desire to enter that field of adventure, to state that miners now esteem it folly, on Lake Superior, to attempt to find workable lodes of metal in any other formation than that of the primitive trap, or the granitic uplift.

There are dykes of altered sandstone, and even trap dykes, which are shot up between the strata of conglomerate, that may mislead; but the findings of metal therein, will necessarily prove bunchy, and of uncertain continuance. [These dykes were illustrated in the lecture by diagrams on the black board.]

There is, however, no necessity of searching in these, as the primoidal trap range of mountains is quite sufficiently extensive. It continues, from Point Kew*a*wenon, at least 300 miles, to the Mississippi river, and occupies, irregularly, the space corresponding with that reaching from the St. Peters to the Chippewa rivers where they enter the Mississippi. And it is more than probable that the same range continues and forms the spurs of the Cordilleras, where the south-eastern Mexican mines are worked.

I would respectfully remark, that the stories of individual losses or gains at this business is no sort of a criterion of the probable result as a well defined, settled business, either as it respects the public good, or well directed private adventure.

If a man makes a miss by allowing his investment no ordinary chance of success, it does not argue that the country will produce nothing desirable; neither does it settle the question of the claims of the mining business to patronage with the prospect of profit.

On the other hand, some have made valuable *discoveries*, and a division of the risks among others has made the discoverer fortunate, without waiting the process of returns from the mines.

I have no doubt but that well directed explorations will continue to disclose new and valuable mines, and when the process of working the ores shall have been brought to greater perfection, and a market opened at some convenient harbor on the lake, for the dressed ores, an extensive busines

Plate III. Vol. XIII. 3rd Series.

Journal Franklin Institute

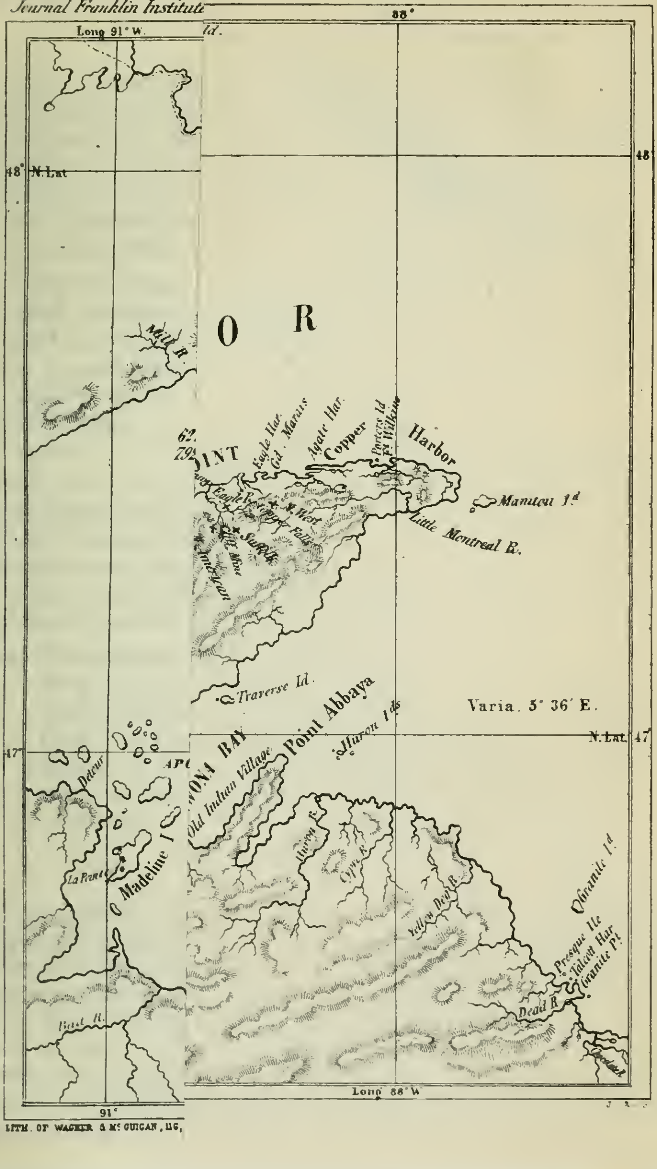

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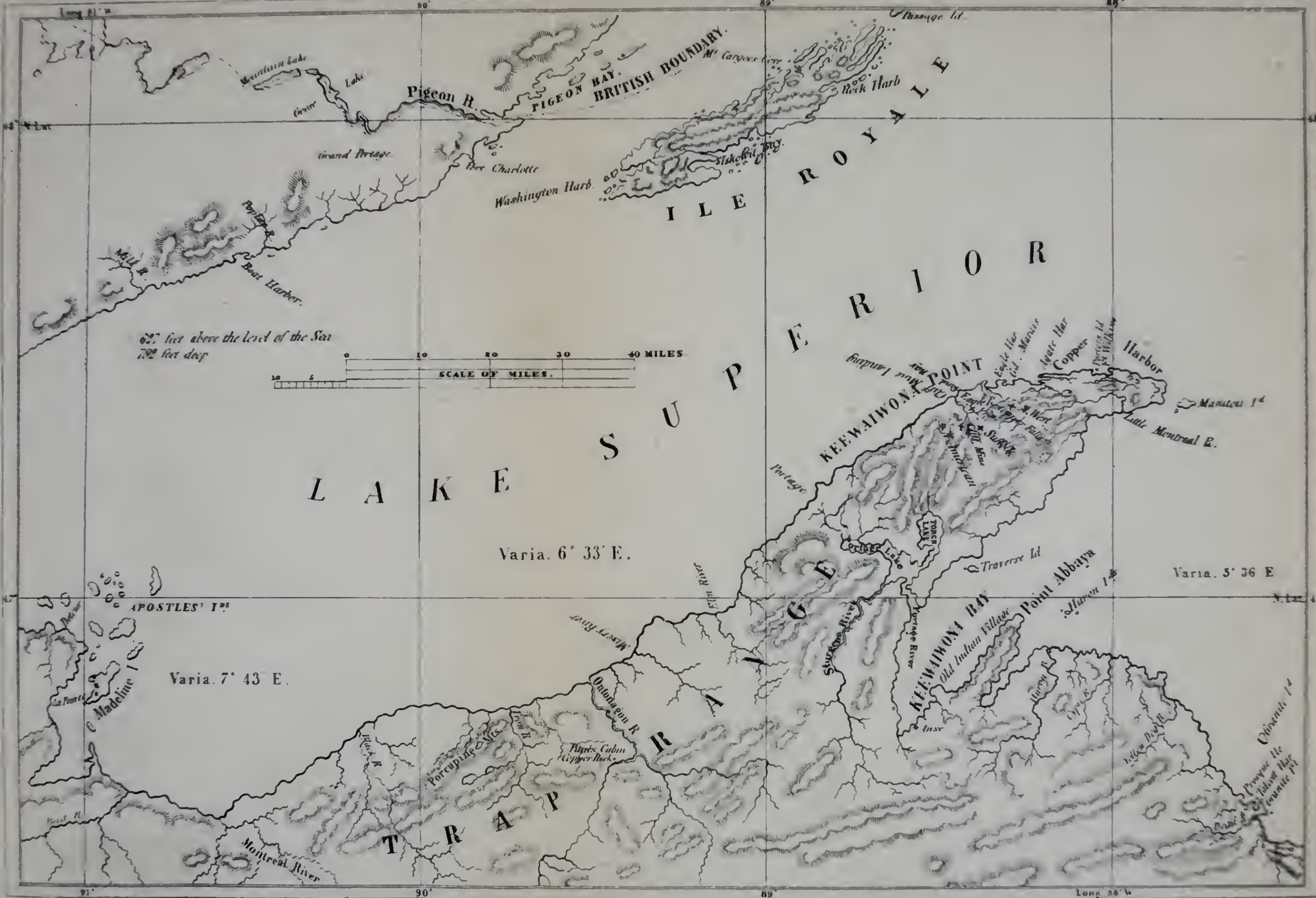
Plate III. Vol. XIII. 3^rd Series



LITH. BY WAGNER & M^c GUIGAN, 116, CHESNUT ST. PHILA the ores shall have been brought to greater perfection, and a market opened at some convenient harbor on the lake, for the dressed ores, an extensive business will spring up, profitable to the adventurers, and highly useful to the American people.

Notes Appended.

It may be useful to append a few rough notes to the above remarks, for the benefit of any who may desire to avail themselves of the law of Congress adverted to, by first exploring the tracts to which they may claim the pre-emption, viz:—

In order to fit out an exploring expedition for the unsettled forests of Lake Superior, they should provide for each Company's location in one neighborhood, say—

1 good Mackinac boat, cost, perhaps, - -	$40
3 good boatmen, (half breeds,) who will also *pack* provisions and materials through the woods; wages, each, per month,	30
2 or 3 good miners, (one as foreman,) with tools for each location; wages, say, each, per month, - -	30
Tools, each, - - - -	5
2 tents, - - - - -	30

Pork, flour, hard bread, tea, coffee, sugar, butter, peas, and beans, packing bags and cooking utensils for the camp, and a good supply of buffalo robes and Mackinac blankets constitute the outfit, with any additions in the way of "comforts" that the parties may fancy.

To visit that country, it requires an expense of time and money very nearly as follows, viz: Trip out:—

From Philadelphia to New York,	1 day,	$4	board extra.
" New York to Albany,	1 "	2	"
" Albany to Buffalo,	1 "	6	"
" Buffalo to Detroit,	1 "	6	and found.
" Detroit to Saut Ste Marie,	2 "	10	"
" Saut Ste Marie to Cliff mine landing,	1 to 2 days,	6	"
	7 to 8 days,	$34	

Thus requiring, besides expenses at stopping places, about $34, and say 8 days, more or less, of time, in going out to Copper harbor, Eagle harbor, or Cliff mine landing, at all of which places reasonable accommodations, for so new a settlement, may be had. The transit is by steam the entire trip, except three-fourths of a mile at the beautiful rapids of Saut Ste Marie. As a healthful pleasure excursion, I know of none that equals it. [The route *via* Pittsburg and Cleveland is shorter, and perhaps cheaper; but it includes about 120 miles of stage-coach fare, which to some is objectionable.]

BIBLIOGRAPHICAL NOTICE.

Gothic Architecture.

This style of building having of late become very much in vogue throughout the country, for ecclesiastical structures, it becomes important, to all who desire to keep pace with the taste of the age, to make themselves acquainted, at least, with its general principles and most striking peculiarities. To such of our readers who may be thus minded, we would say, that they will find, in the recent additions to our library, two very excellent little works on the subject, that are well worthy of their perusal and study. One is called "Anglican Church Architecture, by James Barr, Architect," and the other, "A Manual of Gothic Architecture, by F. A. Paley, M. A."

Both of these books are of a particularly readable character, and can scarcely fail to interest even those who are uninitiated into the art of which they treat, while, at the same time, such as are familiar with the principles and peculiarities of medieval architecture will derive pleasure from their perusal.

The Anglican Church Architecture, as its name indicates, is confined exclusively to the consideration of the ecclesiastical edifices of England, and is intended as an introduction to the study of those time-honored memorials of a tasteful and ingenious people. The several periods of Anglican medieval architecture are accurately described, and illustrated by numerous beautiful and spirited engravings, and the whole work is one well calculated to promote the diffusion of a correct taste in the peculiar species of architecture of which it treats.

Mr. Paley's work is intended to conduct the reader through the various eras of gothic architecture, showing the distinctive features of each, and presenting an analysis of details exceedingly useful to the student, and well adapted to interest those who are simply desirous to obtain a *general* knowledge of ecclesiastical antiquities. This work is also embellished with many spirited wood cuts, by which the descriptions are rendered intelligible to all classes of readers.

We have been induced to invite attention to these works by the fact that gothic architecture is very far from being well understood and appreciated by many who attempt to use it, its forms being often employed in the most incongruous connexions, and without any of the spirit and beauty that will be found, on close inspection and study, to belong to them. T. U. W.

MECHANICS, PHYSICS, AND CHEMISTRY.

Gases and Explosions in Collieries.

The following interesting document is the report of a commission addressed by Lord Lincoln to Sir H. De La Beche and Dr. Lyon Playfair, for the purpose of obtaining information as to the best means of preventing, or mitigating, the fatal effects which are so frequently the result of the generation of noxious gases in coal mines :—

My Lord,—Having, in conformity with the instructions contained in the Earl of Lincoln's letter of the 27th of August, 1845, directed our attention to the composition of the gases evolved from coal beds, to the mode of ventilating collieries, and to the subject of explosions in them generally, we have the honor to submit the following statement for consideration.

With respect to the gases evolved from beds of coal, they may be viewed as the result of the continued decomposition of the vegetable matter from which coal is derived, a decomposition which may be regarded as still in progress under favorable conditions. Omitting the mineral substances, which, when burnt, are known as ashes, coal is essentially composed of carbon, oxygen, hydrogen, and nitrogen; and the quality of the coal depends upon the relative proportion of these ingredients. When the proportion of the carbon to the oxygen and hydrogen does not exceed about 75 per cent., the coal, in common terms, is called "bituminous," when the carbon amounts to about 85 or 90 per cent., it is termed "anthracite," or stone coal: or, in other words, the most advanced state of decomposition of the original vegetable matter bears the latter name.

During the decomposition a portion of the carbon is removed by its union with oxygen, forming carbonic acid, and another portion by combining with hydrogen, as carburetted hydrogen. Thus, by continued decomposition, the carbon gradually becomes a more important constituent in the remaining part of the original vegetable mass. The change from bituminous coal to anthracite can be produced artificially, and in a manner to illustrate the subject considered geologically. *

Though carbonic acid is, no doubt, found in many of our collieries in such a manner as to show it to be derived not only from the lights, horses, and workmen employed, but also to be partly the result of the progressive decomposition of the coal, it is with the carburetted hydrogen, or firedamp, as it is termed, that the collier has chiefly to contend. This comes upon him in various ways. Some coals more readily emit it than others, and hence they are locally termed fiery seams, beds, or veins. From some coals it would appear to escape more generally from the mass of the bed than from others, the gas gradually accumulating from the discharge over a wide surface. Other beds, again, are more fiery in the softer than the harder portions, and where joints or fissures are common. When two or more seams of coal, having different qualities, make up a workable bed, one will sometimes be more fiery than the other. Again, much depends, all other circumstances being equal, upon the kind of roof or covering rock of a coal-bed. If this be sufficiently porous, as many sandstones are, the conditions for the escape of the firedamp upwards through superincumbent rocks are more favorable than where the roof is composed of clay or argillaceous shell.

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* Specimens in illustration of this, made by coking coal in a very gradual manner, are deposited in the Museum of Economic Geology.

The dislocations of the strata, termed "faults" or "troubles," act frequently also as channels for the passage of the firedamp into the works, as they conduct the gas from coal seams beneath, which may be highly charged with it, although the seam under work may be free.

Although we may regard a large proportion of this gas as previously formed, and ready to escape when the necessary conditions, such as those of colliery workings, present themselves, we can scarcely suppose that carburetted hydrogen is not also formed during the time occupied by the progress of the same workings, much being evolved from the older portions of them. The manner in which splinters of coal are thrown off during the cutting of some beds has led to the hypothesis that the gas may be present in a liquid state, produced by condensation, so that when the needful pressure is removed during the progress of the work, the sudden expansion of the firedamp from a liquid to a gaseous form throws off the fragments. The force also with which the gas bursts suddenly forth from clefts or joints in some beds of coal is so considerable as to prove much previous compression, particularly when those bursts or blowers last only for a short time. When they continue for protracted periods, we may infer a more constant supply from continued decomposition of the coal, though the first sudden burst would point to compression. It has been inferred that the small cavities in which the fluid gas is confined can be detected by the microscope in some coals. It is probable that soft places, the sides of joints and fissures, and the walls or faults, are more favorable to the decomposition of the coal than its more solid portions.

The escape of firedamp is generally influenced by the barometrical state of the atmosphere, especially when much of the gas has become accumulated in the wastes or goafs. This is more or less experienced in all pits; but one striking case was pointed out to us by Mr. Jobling, of Jarrow Pit. In a pit of which he is the viewer, the gas issues from cracks in the roof of the seam, and in low states of the barometer is evolved in considerable quantity. When the barometer is high, instead of this issue of gas, there is a sensible current of air which enters into the cracks. When this inward current takes place, the pit is worked with naked candles; but when the evolution of firedamp commences, Davy's lamps are employed.

Assailed in this manner by a gas which, when mingled with atmospheric air in certain proportions, is highly explosive, a knowledge of its exact composition becomes a subject of great importance to the collier, since effective precautionary measures, more especially as regards the lights employed, must necessarily depend upon such knowledge.

Dr. Henry, Sir Humphry Davy, in this country, and Bischoff and others on the continent, have examined into the nature of the explosive gases of mines, but with results differing from each other; for while the English chemists found them to consist of carburetted hydrogen, with little or no admixture, the continental chemists have described them as very complex mixtures of olefiant gas, carburetted hydrogen, carbonic oxide, hydrogen, nitrogen, oxygen, and carbonic acid. On such a point ignorance would be culpable; and we were instructed to bring our knowledge up to the present advanced state of chemical analysis. Whilst we were engaged in this research, Professor Graham made a report to the Chemical Society on the same subject. The previous investigations of this chemist had rendered him well fitted for the task, and the results of his inquiries (according, as they do, with our own) amply guarantee that the subject, as far as relates to this country, may now be considered as decided, and show that the importance of an exact determination had simultaneously engaged the attention of the public.

It is unnecessary to describe in detail the methods which we pursued in the analysis; it may be sufficient to state that we adopted the methods mentioned in a report to the British Association on the analysis of gases by Professor Bunsen, and one of us. We may, therefore, at once tabulate our results, merely stating that we have devoted much attention to this investigation, so as to remove doubt upon a subject so important to the interests of the public. The gases were collected in various ways, some from blowers, others from the freshly exposed surfaces of the coal while the gas issued out with a singing noise, others from the explosive atmosphere of pits.

Gases.	Wallsend, from Pipe on Surface.	Wallsend, Bensham Seam.	Jarrow, Bensham Seam.	Hebburn, Bensham Seam. 161 fathoms deep.	Jarrow, Low Main.	Jarrow, 5·4 Seam.	Gateshead, Oakwell Gate, 5·4 Seam.	Coal 24 feet below Bensham seam, Hebburn Colliery.
Carburetted Hydrogen,	92·8	77·5	83·1	86·0	79·7	93·4	98·2	92.7
Nitrogen,	6·9	26·1	14·2	12·3	14·3	4·9	1·3	6·4
Oxygen,	0·0	0·0	0·6	0·0	3·0	0·0	0·0	0·0
Carbonic Acid,	0·3	1·3	2·1	1·7	2·0	1·7	0.5	9·0
Hydrogen,	0·0	0·0	0·0	0·0	3·0	0·0	0·0	0·0

The general result of this examination is, that the only inflammable constituent present in the explosive gas of collieries is carburetted hydrogen or firedamp; there is not a trace of olefiant gas, and only in one out of the eight gases analyzed is there hydrogen. It follows, from the previous analyses, that the issue of firedamp into the atmosphere of a mine must deteriorate the air, by adding an undue proportion of nitrogen gas; in one case this gas amounts to 21 per cent. During an explosion the oxygen necessary to the respiration of the workers is removed by uniting with the carbon of the firedamp, and thus producing carbonic acid, a gas most fatal to animal life. This carbonic acid, mixed with the residual nitrogen of the atmosphere, and that present in the explosive gas itself, forms what is termed after-damp, which produces effects more fatal even than those arising from the explosion. It often happens, that after an explosion a sufficient quantity of oxygen remains to support the respiration of those who survive its effects, were it not for the presence of carbonic acid. This gas, when present in no greater proportion than one or two per cent., is capable of producing the most injurious effects. It has therefore been suggested, that cheap mixtures, made of substances capable of absorbing carbonic acid, such as glauber salts and lime, would prove useful to those who try to aid the sufferers after the explosion. Such a mixture placed in a coarse bag and applied to the mouth would effectually absorb the carbonic acid, and prevent it exercising an injurious effect on respiration. Certainly the want of some such precaution in the case of the Jarrow explosion caused the death of a very meritorious man, Jacob Difty, the overman of the pit.

An explosion is, however, generally attended with much more complex results than those described as attending the combustion of carburetted hydrogen. The amount of firedamp which may be first ignited may be trivial, and yet produce the most disastrous effects. From its lightness it accumulates at the upper part of the passages, and diffuses with considerable difficulty, often acting as a train, and communicating the explosion to the pent-up reservoirs of gas in the goafs. It is thus that in almost all accounts of explosions two are generally described as taking place; the first local, and at the seat of the explosion; the second more general, and aided by an accumulation of foul gas in other parts of the pit. In the case of Jarrow, the heat attending the explosion was so intense as to have thoroughly coked to the depth of nearly one quarter of an inch the coal lining part of the walls of one of the passages; an effect which could scarcely be conceived without supposing that the flame played for some time upon it with the intensity of a blow-pipe flame. The surface of coal thus acted upon was so considerable, that the amount of explosive gases evolved during this coking must have been far from insignificant, and may have aided the explosion itself. Add to this, that the first effect of the explosion is to blow up and ignite the immense quantity of coal dust lying about the pit, and not only produce from it an evolution of gas, but also occasion the production of much carbonic acid. And it cannot escape attention that the whole subject becomes involved in much complexity. It is known that a certain mixture of air with carburetted hydrogen prevents its accendibility; and, in the case of pure carburetted hydrogen, the proportion has been ascertained to be not less than 15 times its own bulk. But the variation in composition of the firedamp of different mines, the uncertain modes of its issue, and the absence of any ready means of ascertaining its quantity, prevent any general rule being given as to the amount of air which should be thrown into mines to prevent the atmosphere ever attaining the explosive state. All this must be determined by practice to suit the varying conditions of different mines. It is certain that improvements might be made on the rude methods now in use for effecting the necessary mixture. The firedamp being, from its lightness, at the top, is not quickly influenced by the current of cold heavy air descending the downcast shaft, and circulating through the passages. It is therefore not unfrequent to see colliers flapping their jackets among this light gas, so as to dilute it with the sufficient quantity of air, and thus disturb the train of communicating gas which, in a foul state, may connect two dangerous parts of a pit. Mechanical contrivances, such as fanners, would more efficaciously produce the result than the inefficient extemporaneous means referred to; but, in general, such arrangements are only necessary when, from a defective ventilation, the current of air through the pit is not sufficiently strong.

Various artificial means have been proposed to facilitate the withdrawal of firedamp from a pit. Suggestions have been made to take advantage of the lightness of the gas by favoring its ascent to the upper parts of the pits, and drawing it off by special air ways. Pipes let down into the wastes have been proposed for the same purpose, while other suggestions have been made of pipes to blow in air at the tops of the passages, so as to cause the dilution of the gas.

We do not stop to consider these plans, because, as we have already stated, the conditions under which coal is worked are so numerous, that a plan which might prove useful in one pit would be wholly inapplicable and sometimes positively injurious in another, and the legislative application of any one plan might prove highly prejudicial to this great branch of national industry.

In 1835, a Select Committee of the House of Commons was appointed to inquire "into the nature, cause, and extent of those lamentable catastrophes from explosions which have occurred in the mines of Great Britain, with the view of ascertaining and suggesting the means of preventing the recurrence of similar accidents." Numerous witnesses were examined before this Committee, a body of important evidence collected, and a report published in the same year,—a report replete with váluable information, and to which we would wish to refer for ample details connected with the general mode of working collieries, especially in the north of England. The Committee observe, on the subject of colliery explosions, that while the loss of interrupted trade by these accidents is enormous, "it is nevertheless rather with reference to the cause and interest of humanity than in a pecuniary point of view that this inquiry has assumed its great importance." This Committee did not recommend any remedial measures.

The difficulty experienced of obtaining accurate information respecting the number of lives lost from colliery explosions within a limited period is nearly as great at the present time as it was in 1835. And it should be borne in mind that the number of lives lost by the great explosions, those which chiefly become known and arrest public attention, by no means affords a correct view of the collective loss of life sustained by colliery explosions generally, including the minor accidents not commonly heard of beyond limited districts; neither does it represent the injury sustained by these explosions, short of the loss of life, but from which many persons are more or less disabled.

The Committee were enabled to ascertain that, during the 25 years preceding these inquiries, 2,070 persons had perished from colliery explosions; and they considered this number much underrated. During the last 10 years the rate of loss of life from this cause has certainly not diminished. The experience of the past year has shown that considerably more than 100 persons have been known to have thus perished.

It has so unfortunately happened that, during the few months we have been engaged upon this inquiry, two explosions, one at Jarrow, in Durham, and the other at Risca, in Monmouthshire, have together deprived 76 persons of their lives: 41 having perished at the former and 35 at the latter.

By direction of Sir James Graham and the Earl of Lincoln, we were commissioned to ascertain the causes of both explosions. It so occurred that, being at that time in the south of Ireland, engaged on the duties of the geological survey, Sir Henry de la Beche could not reach Jarrow in time for the inquiry, and therefore the investigation into the cause of the explosion at that place devolved upon Dr. Playfair, who, under these circumstances, availed himself of the services of Mr. David Williams, at that time one of the geologists attached to the geological survey of Great Britain, and well skilled in coal mining, but now in the service of the East India Company, examining the coal resources of India. The results of this inquiry are given in the accompanying report by Dr. Playfair.

Immediately after the explosion at Risca, on the 14th of January, 1846, instructions were again received to proceed without loss of time to that colliery. Dr. Playfair being, however, so engaged upon duties in London, that he could not readily proceed to Risca, the investigation was undertaken by Sir Henry de la Beche, aided by Mr. Warrington Smyth, mining geologist to the geological survey of the United Kingdom, who was in every respect qualified for such an inquiry. The accompanying report contains the results of this investigation.

During these inquiries it became very important carefully to consider the kinds of lights employed in collieries, and the usual regulations respecting them. The subject was not new to us, since for more than 25 years the mode of working collieries in different parts of the United Kingdom, as also on the continent of Europe, had engaged the attention of one of us. On the subject of safety lamps, of lighting generally, and of the regulations connected with it, the Committee of 1835 collected a large amount of evidence, more especially regarding our northern collieries. In the report of the South Shields Committee of 1843 there is also much information on this head. To these reports, therefore, we would wish to refer for sufficient information on the subject. Civ. Eng. & Arch. Jour.

(To be continued.)

On the Application of Gunpowder as an Instrument of Engineering Operations, exemplified by its use in Blasting Marl Rocks in the River Severn. *By* GEORGE EDWARDS.

[Read at the Institute of Civil Engineers.]

Many plans have been proposed at different times for the improvement of the Severn. It is sufficient, however, for the present purpose to state, that in 1842 an Act was obtained, under the advice of Mr. W. Cubitt, V. P. Inst. C. E., for the improvement of 43 miles of its length, from Stourport to Gloucester; over which distance, in many places, there was not two feet depth of water during the summer season. The object of the proposed works is to increase this depth to six feet of navigable water during all seasons. Above Worcester, the additional depth is obtained partly by dredging, but chiefly by a series of four weirs, varying between 300 and 400 feet in length, with side locks for the traffic. Between Worcester and Gloucester, (a distance of 29 miles,) it is proposed to obtain the required depth, partly by contracting the channel by embankments of fascines, and partly by dredging. Messrs. Grissell and Peto having undertaken the entire completion of the works, from Stourport to Gloucester, the superintendence of the dredging operations was entrusted to the author. The shoals to be removed by dredging are generally isolated, varying from 100 yards to half a mile in length, and they require excavating to a depth of from three to five feet. A large proportion of these shoals consists of alluvial gravel, without flints, but principally of quartzose and granitic pebbles, varieties of porphyry and of compact and granular sandstone. This material, although very hard in some places, offered no engineering difficulties. Other shoals consist of denuded beds of hard red marl; this material being found in every instance when the river impinges upon the eastern or western limits of its valley. In most places it was so hard as to render its removal by the dredging machine quite impracticable; and it is the object of the present communication to describe the method of blasting, or breaking up, this material, with gunpowder, so as to render it capable of being dredged up with facility.

That part of the river Severn, above described, traverses nearly north and south the great plain of red marl of the new red sandstone formation, the bed of the river, from Stourport to about a mile below Holt bridge, near Ombersley, being formed through the upper strata of the new red sandstone; upon this lies the great bed of red marl, (in places saliferous,) dipping at a small angle, but irregularly, to the south-east. The river traverses the whole of this strata, which is probably more than 1000 feet in thickness, passing through the upper strata, and entering the lias formation above Gloucester.

The red marl is generally considered by geologists to be formed from the debris of older rocks, and it appears to be totally devoid of organic remains. It lies generally in beds, rarely exceeding 15 inches in depth, and often much less. It is divided occasionally by strata of greenish grey marl, and near the upper part of the formation by thin, but very hard, beds of shaly, or imperfect lias.

It is difficult to describe the comparative hardness of materials, but when it is stated, that in many places it was impossible to cause a steel chisel-pointed boring tool to enter it by any ordinary exertion, by hand, from a boat, it will be conceived that it could not be readily raised by dredging. After exposure to the action of the air, it breaks up into small fragments, almost like the slaking of lime, so that solid blocks, which could only be broken, by the application of considerable force, into sharp-edged fragments, would, in the course of a few days, fall to pieces, and afford no criterion of its hardness in an undisturbed state.

When the dredging machine was tried upon one of these marl shoals, it was found impossible to raise above 50 or 60 tons per day, and that with constant risk and repeated accidents to the machine; but such rate of progress was totally incompatible with the required progress of the work. Attempts were first made to break it up by driving iron bars into it, and prizing it up, but this plan did not answer. A second attempt was made to loosen it with a very strong plough, something like a "subsoil" plough, which was proposed to be pulled through the marl by a powerful crab fixed on a barge, the plough being guided by a strong pole; the effect produced was, however, so superficial, and the expense of labor was so great, that this method was also abandoned, and experiments were made to ascertain the effect and probable cost of using gunpowder. These were so satisfactory, that it was determined to blast all the marl shoals, previous to dredging them. In January, 1845, as soon as the requisite materials and establishment could be prepared, this operation was commenced, and has since been carried on with no other interruptions than those occasioned by freshes in the river; the total length of blasting required (about a mile and a half) being now nearly completed, and a considerable portion of the marl since dredged up, at the rate of 200 or 300 tons per day, with perfect facility.

The most economical method of using powder, to break up a depth of rock like that described, would probably be to obtain a face of the required depth at one end of the work, to put in a row of shots at the back of it, and after each discharge to remove the loosened marl; continually repeating the process; but this method would have been open to many serious objections. The dredging machine and the blasting gang would have been constantly waiting for each other, and, having but two dredging machines to perform the work, it was of great importance to economise their time in every possible way. By such proceedings, also, a constant obstruction to the navigation would have been created, equal to the whole width of the new channel. The number of men that could have been employed in blasting would also have been very limited. These objections, in this particular instance, far outbalanced any little saving of gunpowder. It was therefore determined to put in perpendicular shots, throughout the site of the channel, at such distances as experience might prove to be best, and proceedings were commenced with spaces of six feet from centre to centre of the shot holes.

Six rafts were used, as stages to work from: they were each formed of four baulks of timber, about 40 feet long; the baulks, placed in pairs, were secured, at a distance of four feet apart, by cross pieces, six inches square, well spiked to the baulks at intervals of six feet; these were covered with deals three inches thick, laid lengthways of the raft, a space of 12 inches in width being left open along the centre. The ends of the rafts were provided with strong ring bolts to moor by. These rafts were confined to one bank of the river by ropes, and retained at the required distance from it, by a series of "sets," or booms, abutting against the bank. At the up-stream end of the raft, was a large barge fitted up as a blacksmith's shop, for the necessary repair of the tools,—with dwellings for the watchman, the ganger, &c. The bows of the barge were strongly fortified, and a strong oblique boom of large baulks reached from it to the shore, so as to protect the whole fleet from the craft coming down the river. At the down-stream end was another barge, fitted up as a powder magazine and as a shop, furnished with every necessary for the manufacture of the cartridges, and for the storing of their material. The words "powder magazine," in large letters, were painted on both sides of this vessel.

The first operation consisted in placing and securing, in their proper positions, the pipes through which the holes were to be bored. Small stakes, painted with a series of numbers, were first driven into the bank, parallel to the work, at distances of six feet apart; as far behind them as the slope would allow, was another row of stakes parallel with the first, so that a line drawn through two stakes would be at right angles with the river, and a person standing behind the two stakes could readily direct the workmen when to lower the charge-pipe, which was then secured in its place, in the opening of the raft, by a "timber-dog," driven into the raft on each side of it. The pipes were of wrought iron, drawn for the purpose by Messrs. James Russell and Sons, of Wednesbury: they were three and a half inches in diameter, three-sixteenths of an inch thick, and nine feet long.* Two collars, half inch square, were shrunk on them near the upper end, for the purpose of retaining a rope, by which they were secured when the charge was fired. When the depth of the water increased, these pipes could be lengthened four feet by an additional piece prepared for that purpose; this joint was made by shrinking on a collar, six inches long, over the joint. The pipe being in its place, was driven through any gravel that might remain and a few inches into the marl.

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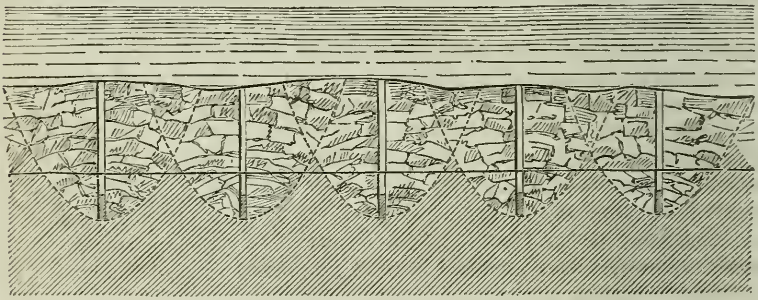
* Where the marl was so deep as to require three, or more, pounds of powder, it was found that the cartridges of such diameter as could be used in these small bores were so long as to lose part of the effect of the gunpowder; subsequently, pipes of 4 inches diameter were used with advantage.

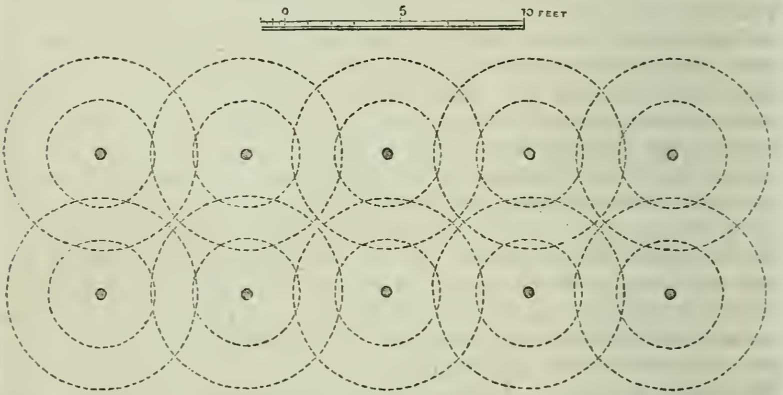
The gravel was generally so thick upon the marl, that it was requisite first to remove it, by means of the dredging machine. To protect the thin edges of the pipes whilst being driven, a cast iron cap, or plug, was used, which received the blows from a heavy wooden beetle; the interior of the pipes was next cleared of any sand, or gravel, that might have entered while putting them down. The principal tool used for this purpose was an iron bucket, or cylindrical tube, two feet in length, of as large a diameter as would pass down the hole; it was furnished, at the bottom, with a valve opening inwards, and was jointed to a round rod, of the requisite length, half an inch in diameter, and, when used with a pumping motion, quickly brought up whatever could not enter at the valve.

Fig. 1.



Horizontal line shows depth of dredging

Fig. 2.



The boring then commenced; a gang of three men being stationed at each pipe. The first operation was that of the jumper, which was made with a single steel edge, a little rounded. The jumpers were of round iron, one and one-eighth inch in diameter, except two feet in length at the lower end, which was one and a half inch in diameter. For general use, they were 15 feet long, and weighed about 52 lbs. each; after working them till they were nearly set fast, an auger was inserted to raise the plug of loosened marl, and to render the hole true.

The shell of the auger was 20 inches long, and nearly closed up, the better to retain the loosened borings.

The shot holes were bored two feet below the proposed bottom of the dredging, as it was supposed that each shot would dislocate, or break into small pieces, a mass of marl of a conical or parabolic form, of which the bore hole would be the centre, and its bottom the apex, so that four adjoining shots would leave between them a pyramidical piece of marl, where the powder would have produced little or no effect. By carrying the shot holes lower than the bottom of the intended dredging, the apex only of this paramid was left to be removed, and in practice this was found to form but a small impediment. (figs. 1 and 2.) A second reason was, that, if the removal of the shoals should cause the level of the summer water to fall lower than was expected, the marl might still be found sufficiently broken, to enable a greater depth to be obtained without further blasting.

The cartridges, or charges, were formed of strong duck or canvas bags, somewhat tapered at the bottom; these were filled with the required charge of powder, varying from two pounds to four pounds, according to the depth of the marl;* the end of a coil of Bickford's patent fuse was inserted to the centre of the powder, and the neck of the bag was carefully gathered up round the fuse, and well tied with small twine. If the cartridge was small, it was then dipped into melted pitch, which had about one-fourth of tallow melted with it, or otherwise the melted pitch was ladled over it, till it was uniformly coated; in this state, the cartridges were hung to drain and stiffen. When hard, they were well rubbed over with tallow, and lastly powdered over with dry whiting. The tallow, whilst it insured the stopping of any little cracks in the pitch, facilitated the passage of the cartridge down the hole; the whiting also prevented the pitch from adhering to anything. It has already been stated, that the powder was ignited by means of Bickford's patent fuse; but as this material is never made in lengths exceeding 48 feet, it was found expedient, in order to save waste, to use the whole coil, cutting it off at the requisite length when absolutely in the hole, and using the remainder in the same way, till the whole was used.†

The charge was carefully pushed down into the hole by a wooden ramrod of suitable diameter, with the end rounded; the same instrument was used for ramming down the tamping. The material found to answer best for this purpose was the small fragments of hard marl, separated by the action of the weather from the lofty escarpment at each of these shoals; this was gradually filled into the holes, and rammed solidly, till the bore was full up to the surface; the timber dogs which held the pipes were then removed, the pipes were loosened from the marl, ropes were attached to the pipes and to the raft, or to some loose pieces of timber, and the shots were fired. Generally there was little external effect beyond the pipes being lifted a few inches, though sometimes they would be blown up several feet, and occasionally the water would be forced up through the pipe to a height of 40 or 50 feet. All the gangs commenced their holes in the morning, and they were generally all ready to fire at the same time, which was always done, as it caused least interruption to the work.

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* The weights of powder used for depths of four feet, four feet six inches, and five feet, were, respectively, about two pounds, three pounds, and four pounds.

† The short remaining ends, though useful for less depths, were of little value, from the difficulty of splicing them together. This operation, though troublesome, was resorted to with success on one occasion whilst waiting the arrival of a parcel of fuse. On returning the short ends to Messrs. Bickford they allowed half the length of new fuse in exchange.

It was a rare occurrence for a shot to miss fire—probably not once in a hundred shots; the failure arising generally from a leak at the joint between the fuse and the bag. If the leak was not very serious, the shots were often saved by the following somewhat singular expedient. An iron bar, $\frac{5}{8}$ inch in diameter and of sufficient length, pointed at the end, was kept in readiness, and when required the end was heated red hot, put quickly through the water into the tamping, through which it was driven as rapidly as possible into the powder, which in nine cases out of ten it was still hot enough to ignite.

The result of the whole work being invisible, great care was necessary in order to prevent mistakes and omissions. As each shot was ignited, a red mark was laid against its corresponding stake upon the bank; when it had gone off, each shot was carefully examined with a steel chisel-pointed searcher, to prove that the required effect had been produced to the determined depth; when so found, the red mark was inserted into the top of the stake, as a certificate of that shot having passed examination; the numbers so certified were then transferred to a book kept for tbe purpose, and if a shot was found ineffective, another was put in the same place.

To afford space for the workmen, every alternate hole was first made, and afterwards those which had been left between them; one line being completed, the whole line of raft was moved 6 feet outwards to the next line, and so on till the required width was obtained. The whole establishment was then dropped down the length of the rafts, and the process was repeated. When the men had become used to the work, each gang would sometimes get down four shots per day, so that with fifteen gangs sixty shots have been fired per day.

It may be objected to the use of the patent fuse, that the ignition of a number of charges simultaneously by the galvanic battery would have produced better effect, at less cost, and in a more scientific manner. The author commenced the work under a different impression, and subsequent experience with the battery has not altered his opinion. When it is required to separate a large stone from its bed in the quarry without breaking it, nothing can be better than the numerous simultaneous discharges, which can only be obtained by the use of the battery, but the object in this work, on the contrary, was to break the mass to pieces as much as possible, which it is conceived would be more likely to be effected by distinct discharges.

Then as regards cost: the patent fuse No. 3, carriage included, cost $\frac{6}{10}$ths of a penny per foot; if the average length is taken at 15 feet, that is just nine-pence per shot, a sum which would barely pay for making the arrangement of wires necessary for the galvanic ignition. It was also found, from the compressible nature of the canvas cartridges, that the arrangement of the wires was very liable to be disturbed, during the insertion of the cartridge into the hole, or by the subsequent ramming of the tamping. After considerable experience, therefore, and the use of nearly 100,000 feet of the patent fuse, the author feels that he is only doing an act of justice to the Messrs. Bickford, in stating the perfect satisfaction which the use of their ingeniously manufactured material has afforded him, in the prosecution of the work now described.

There now only remains to be given the cost of the operation above described. The first cost of the establishment or plant, sufficient for 6 months' work, was £300. This includes the waste and use of timber, in the raft, stages, booms, &c., hire of barges, and cost of fitting them up for the work, cost of pipes for boring, iron and steel for tools, deducting estimated value when done with, sundry ironmongery, waste and loss of ropes and other small stores.

More than four thousand shots have already been fired, and in the six months, at a low computation, six thousand will have been fired. This number gives just one shilling per shot, as the proportionate share per shot of the cost of the plant; this would of course be much less if the work was to be continued.

The cost of labor per shot varies from 2*s.* 6*d.* to 4*s.*; this sum, however, must be understood to cover the wages of the whole establishment as under: Superintendent of the work—Foreman and time-keeper—Examiner of the shots—Maker of cartridge and two assistants—Carpenter—Blacksmith and Hammer-man—Laborers, some at 3*s.*, majority at 2*s.* 6*d.* and 2*s.* 9*d.*—Watchman.—Thus the total cost per shot is as under:—

Use of material, 1s.; labor, average, 3s. 3d.; pitched bag, 3d.; 3 lbs. of powder, at 5½d., 1s. 4½d.; 15 feet of patent fuse, 9d.; pitch, tallow, twine, coals, &c., say, 4½d.; making, together, 7s.

If, therefore, the shots are 6 feet apart, and an average depth of 3 feet is broken up, 4 cubic yards are prepared for dredging at the cost of one shot; or the cost of the whole operation is 1*s.* 9*d.* per cubic yard. Distances of 5 feet apart were used in some very hard shoals, and spaces of 7 feet were tried in some that were softer than usual; spaces of 6 feet apart, however, appeared to be generally sufficient.

Civ. Eng. & Arch. Journal.

The Manufacture of Ruby Colored Glass.

[The following conclusion of an article on the art of glass painting, published in Beckman's History of Inventions, is copied from the London Mechanics' Magazine. The reader will find much on the manufacture of glass, both white and colored, in the previous volumes of the Journal of the Franklin Institute, particularly the 9th, 10th, 11th, and 12th volumes of the present series. Com. Pub.]

I shall now conclude these observations by a few notices respecting glass tinged by fusion with gold, which, though never brought into general use among glass painters, has, I know, been employed in one or two instances, flashed both on crown and on flint-glass. Not long after the time when the art of making the copper-red glass was lost, Kunkel appears to have discovered that gold melted with flint glass was capable of imparting to it a beautiful ruby color. As he derived much profit from the invention, he kept his method secret, and his successors have done the same to the present day. The art, however, has been practised ever since for the purpose of imitating precious stones, &c., and the glass used to be sold at Birmingham for a high price under the name of *Jew's Glass*. The rose-colored scent-bottles, &c., now commonly made, are composed of plain glass, flashed or coated with a very thin layer of the glass in question. I have myself made numerous experiments on this subject, and have been completely, and at last uniformly, successful in producing glass of a fine crimson color. One cause why so many persons have failed in the same attempt,* I suspect, is, that they have used too large a proportion of gold; for it is a fact, that an additional quantity of gold, beyond a certain point, far from deepening the color, actually destroys it altogether. Another cause probably is, that they have not employed a sufficient degree of heat in the fusion. I have found that a degree of heat, which I judged sufficient to melt cast-iron, is not strong enough to injure the color. It would appear, that, in order to receive the color, it is necessary that the glass should contain a proportion either of lead, or of some other metallic glass. I have found bismuth, zinc, and antimony to answer the purpose, but have in vain attempted to impart any tinge of this color to crown-glass alone.

Glass containing gold exhibits the same singular change of color on being exposed to a gentle heat. The former when taken from the crucible is generally of a pale rose-color, but sometimes colorless as water, and does not assume its ruby color till it has been exposed to a low red-heat, either under a muffle or in the lamp. Great care must be taken in this operation, for a slight excess of fire destroys the color, leaving the glass of a dingy brown, but with a blue transparency like that of gold-leaf. These changes of color have been vaguely attributed to change of oxygenation in the gold; but it is obviously impossible that mere exposure to a gentle heat can effect any chemical change in the interior of a solid mass of glass, which has already undergone a heat far more intense. In fact, I have found that metallic gold gives the red color as well as the oxide, and it appears scarcely to admit of a doubt, that, in a metal so easily reduced, the whole of the oxygen must be expelled long before the glass has reached its melting point. It has long been known that silver yields its color to glass while in the metallic state, and everything leads one to suppose that the case is the same as to gold.

There is still one other substance by means of which I find it is possible to give a red color to glass, and that is a compound of tin, chromic acid, and lime; but my trials do not lead me to suppose that glass thus colored will ever be brought into use.

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* Dr. Lewis states that he once produced a potful of glass of beautiful color, yet was never able to succeed a second time, though he took infinite pains, and tried a multitude of experiments with that view.—*Commerce of Arts*, p. 177.

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CIVIL ENGINEERING.

An Extract from an Historical and Geographical Examination of the Isthmus of Panama: The different directions in which it may be cut, and the means to be employed. By MICHEL CHEVALIER. *Paris, published by Charles Gosselin,* 30 *Rue Jacob,* 1844.

Translated for the Journal of the Franklin Institute, by Persifor Frazer, Esq.

Nicaragua Route.

(Continued from page 310.)

At the end of the last century, some years before the French revolution, ideas of improvements were every where springing up. The government of Spain had a level carried across between the gulf of Papagayo and lake Nicaragua, coming out on the lake in the neighborhood of the important town of Nicaragua, which has, at this time, a population of at least 20,000 souls. This was the first knowledge they had of the elevation of the lake above the ocean. The engineer Don Manuel Galistro found that the distance from the ocean to the lake was 27,592 metres (30,175 yards). That the summit of the ridge was 83·70 metres (274·61 feet) above the ocean, and 43·70 metres (143·37 feet) above the lake; giving 40 metres (131·24 feet) as the height of the lake above the ocean. Between the lake and the Pacific, the excavation of a canal drawing its water from the lake, would meet with no difficulty, except on a length of 8000 metres (8750 yards), separated from the lake by a distance of 2·50 kilometres (1·55 miles). On this length of 8000 metres (8750 yards), the elevation of the surface above the lake is, at the least, 20 metres (65·5 feet). At one point it falls to 15 metres (49·20 feet); this is at a distance of five kilometres (3·10 miles) from the lake, and up to this point, the maximum elevation does not quite attain 30 metres (98·50 feet). After this depression, the ground rises gradually and attains a height above the lake of 44 metres (144·33 feet); this point is 9300 metres (10,170 yards) from the lake. There are but 2850 metres (3117 yards) along which the height is 30 metres (98·42 feet) or more above the lake, and only one-fourth of this space of 2850 metres exceeds 40 metres (131 feet) in height. Under such circumstances a tunnel is generally pierced, for trenches of a depth of 44 metres (145 feet) are rarely cut—we should say 50 metres (164 feet), taking into account the depth of the bottom of the canal below the surface of the lake—generally, they do not exceed 20 metres (65·60 feet).

To undertake, and to complete, such a trench as that of Huehuetoca, cut with the view of draining the lakes in the neighborhood of the city of Mexico, whose depth, for a length of 800 metres (2625 feet), is from 45 to 60 metres (147 to 197 feet), and for 3500 metres (3827 yards) from 30 to 50 (98 to 164 feet), required such treasures as were at the disposal of the viceroy of Mexico the recollections of the ancient Castilian grandeur, and perhaps, also, the inexperience of Spanish engineers, as regarded tunneling—its cost was immense.

At the present day, however, in a case of necessity, by using the improved means which the engineer has at his disposal, very deep trenches may be cut without any extraordinary expense, providing it is not through a very hard rock. On the canal from Arles to Bonc, for instance, the table land of Lèque has been cut through by a trench 2100 metres (2300 yards) in length, whose greatest depth is from 40 to 50 metres (131 to 197 feet). The expense was less than 4,000,000 francs (about 800,000 dollars), although it was made under the old system. At present, in deep cuttings, the soil is attacked by arms of great power. The railroad and locomotive are employed for the transport of the earth. Man has little else to to do than to dig and to load the wagons. Even this portion of the labor has been lately performed, with great economy, by a machine on the Northern Railroad. The European or American engineers to whom the opening of the isthmus may be confided, will not hesitate to undertake cuttings of 50 metres (164 feet) in depth, unless, indeed, a very hard rock shall be encountered on a large portion of the distance. For such an object as the junction of the two oceans, we may almost attempt the impossible. The results of the survey of Don Manuel Galistro were not made public until after the independence of the State of Guatimala. Mr. Bailey, an officer of the British navy, charged, by the unfortunate General Morasau, then at the head of the government of Central America, with the survey for the canal of the two oceans, discovered them in I know not what archives, and communicated them to Mr. Thompson, the British minister, who published them. But Mr.

Bailey, doubting the accuracy of this exploration, which appears not to have been made in the best manner, re-commenced it, following another line, and we are made acquainted with the result of his labors in Mr. Stephens' interesting work on Central America.

Mr. Bailey's line terminates, like the other, on the lake near the town of Nicaragua. He starts at a point on the river San Juan of the South, two kilometres (1·25 miles) from the Pacific, to which point large vessels ascend the river. He found the distance between the ocean and the lake to be but 25,935 metres (28,362 yards). The highest point of the ground, situated 6211 metres (6792 yards) from the starting point, has an elevation above the sea of 187·78 metres (616·09 feet). The elevation of the lake is 39·11 metres (128·31 feet), and, consequently, it is 148·67 metres (497·77 feet) below the highest point of the line. The space between is quite level. According to a profile of the canal given by Mr. Stephens, after the topographical data of Mr. Bailey, the canal would rise from the lake to fall again towards the ocean. For the first 13 kilometres (7·50 miles) on the lake side, there would be but one lock to overcome a rise of 2·97 metres (9·75 feet); then, on a distance of 1600 metres (1750 yards), six or seven locks would be required to ascend 19·52 metres (64·04 feet). This would bring us to the summit level of the canal, 4800 metres (5248 yards) in length, two-thirds of which would be a tunnel, unless cuttings, of from 25 to 30 metres (82 to 100 feet) in depth, should be preferred. The height of the top of the ridge is such, that a trench from one extremity to the other of the summit level would be altogether impossible. Thence, to the Pacific, the distance is but 4800 metres (5248 yards), on which, a fall of 61 metres (200 feet) is to be provided for. Thus, according to the project published by Mr. Stephens, the canal will rise, by successive locks, 22·49 metres (72·31 feet) above the lake, to find a point where the ridge to be cut through by a tunnel will not be too wide. But in this case we would have to find, at this height, a supply of water sufficient for the demands of the canal. If, on the contrary, the canal is to draw its water from the lake, which will probably be indispensable—for there is nothing in Mr. Stephens' statement indicating other sources for supplying it—the tunnel on a level with the lake would meet the ridge at a point where it is much wider through, and instead of a length of little more than 3000 metres (3280 yards), it would have one of 5500 (6015 yards). European science does not fear to encounter such a work. At Mauvage, on the Marne and Rhine canal, there is a tunnel of nearly 5000 metres (5468 yards). The grand tunnel of the St. Quentin canal, that of Riqueval, has a length of 5677 metres (6208 yards). The summit level tunnel of the Chesapeake and Ohio canal, in America, will be 6509 metres (7120 yards) long. That of Pouilles, on the Burgundy canal, 3333 metres (3645 yards). On the English canals there are a number of tunnels of from 2000 to 4000 metres (2200 to 4400 yards). On the English railroads, we find one of 4800 metres (5248 yards), between Sheffield and Manchester, and on the London and Birmingham road, one of 2800 metres (3062 yards). The railroad from Lyons to Marseilles will also have one of great length. But the tunnel of a maritime canal, on the extremely doubtful supposition that such a thing is admissible, would require nearly double the height and width of those in use on ordinary canals of the largest size, and that on the hypothesis, that the ships passing through are dismasted. Now, a double height and width corresponds with a quadruple section, so that, under the most favorable circumstances, the expense would be also quadruple; that is, at European prices, it would be from 4000 to 8000 francs per lineal metre, or 4,000,000 to 8,000,000 per kilometre (from about $700 to $1400 per lineal yard, or from $1,250,000 to $2,500,000 per mile). Hence, we may conclude, that Mr. Bailey's line is very inferior to that of Don Manuel Galistro, and even that it is inadmissible for a maritime canal.

Of the other routes, precise information is wanting. We know only that from Moabita, the port at the north-west point of lake Leon, to Realejo, the distance is 55 kilometres (34 miles); and to Tamarindo, 14 or 15 (8·75 to 9·25 miles); and that the ground appears favorable for the work. The whole of this country is yet to be explored. These regions, so important to the commerce of the world, so attractive from their beauty, their fertility, and the charm of their climate, have been less frequented by travelers capable of appreciating them, and by men of science, eager in the pursuit of the secrets of nature, than the inhospitable steppes of Tartary, the burning deserts of Africa, or the icy regions of the poles. A description of Mexico and Guatimala, published in Boston, in 1833, (vol. ii., p. 285,) states that the ridge between lake Leon and the Pacific ocean sinks to an elevation of 15·55 metres (51 feet) above the lake. The author adds, that from the lake to the river Tosta, the distance is but 19 kilometres (11·75 miles), and that this river, at a point at which it may be struck, is 91 centimetres (3 feet) above the lake. These facts, should they be verified, are very important. They render unnecessary a cutting of unusual depth, and still more, a tunnel; for a cutting with a maximum depth of 22 metres (72·17 feet) is nothing out of the usual practice of engineers. This book does not mention its authority for the information it gives the public, and I have found no trace of it elsewhere. Nevertheless, when we unite the unanimous testimony of Dampier, of Rouhard, of Dumartray, and of Mr. Stephens, we can hardly refuse to give it credence.

Lake Leon is 47·86 metres (157 feet) above the Pacific. This difference of level may be overcome by 15 locks—supposing that, some day, dams accompanied by locks shall be constructed, at proper intervals, on the rivers San Juan and Tipitapa, or that a lateral canal shall be dug. The canal of the two oceans, therefore, even though carried through lake Leon, will require but 30 locks; taking for granted that the ground between lake Leon and the Pacific coast will permit the opening of a canal drawing its water from the lake, and, consequently, not above its level. We cannot affirm, positively, that this is the case, but our information, from various sources, authorizes us to hope that it is so.

But the mere construction of a canal to the Pacific is not all that is to be done. We must also find a good port to which to carry it. That

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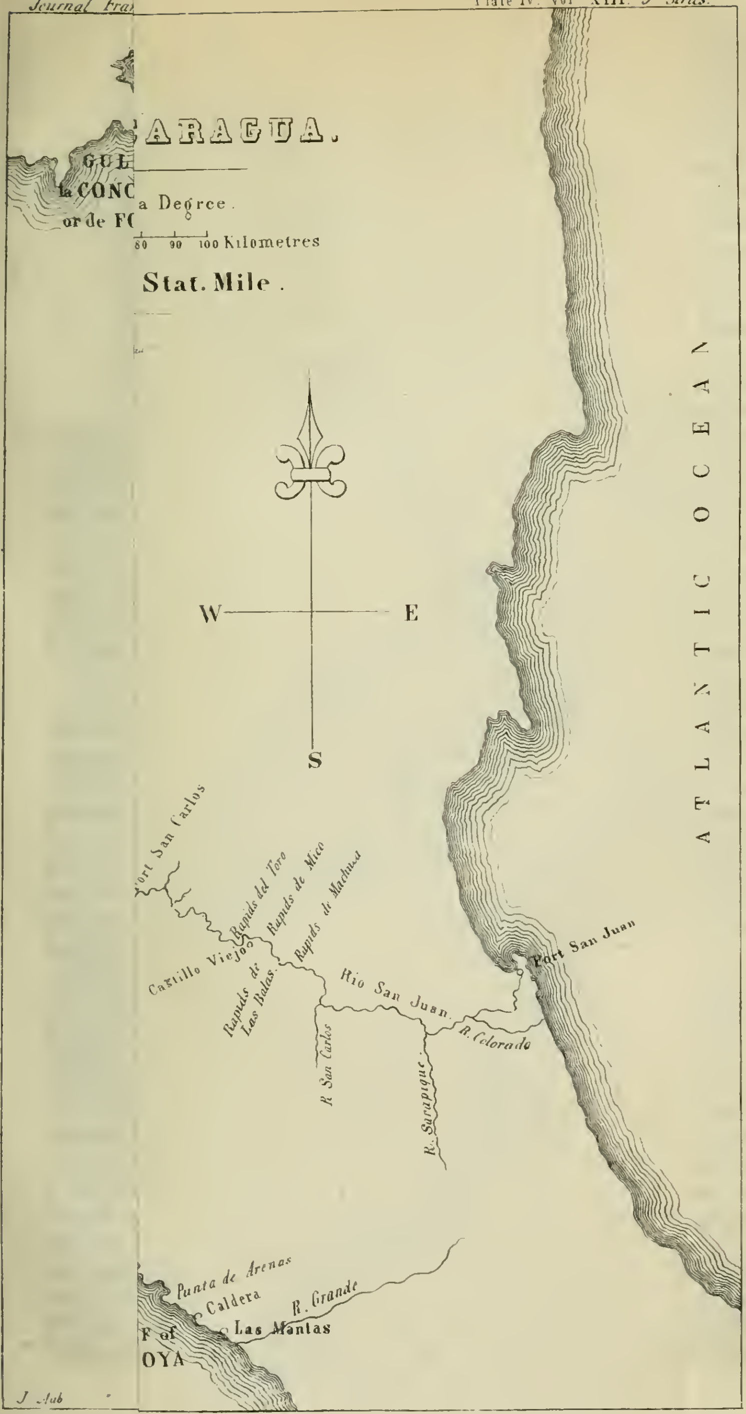
Plate IV. Vol XIII. 3rd Series.



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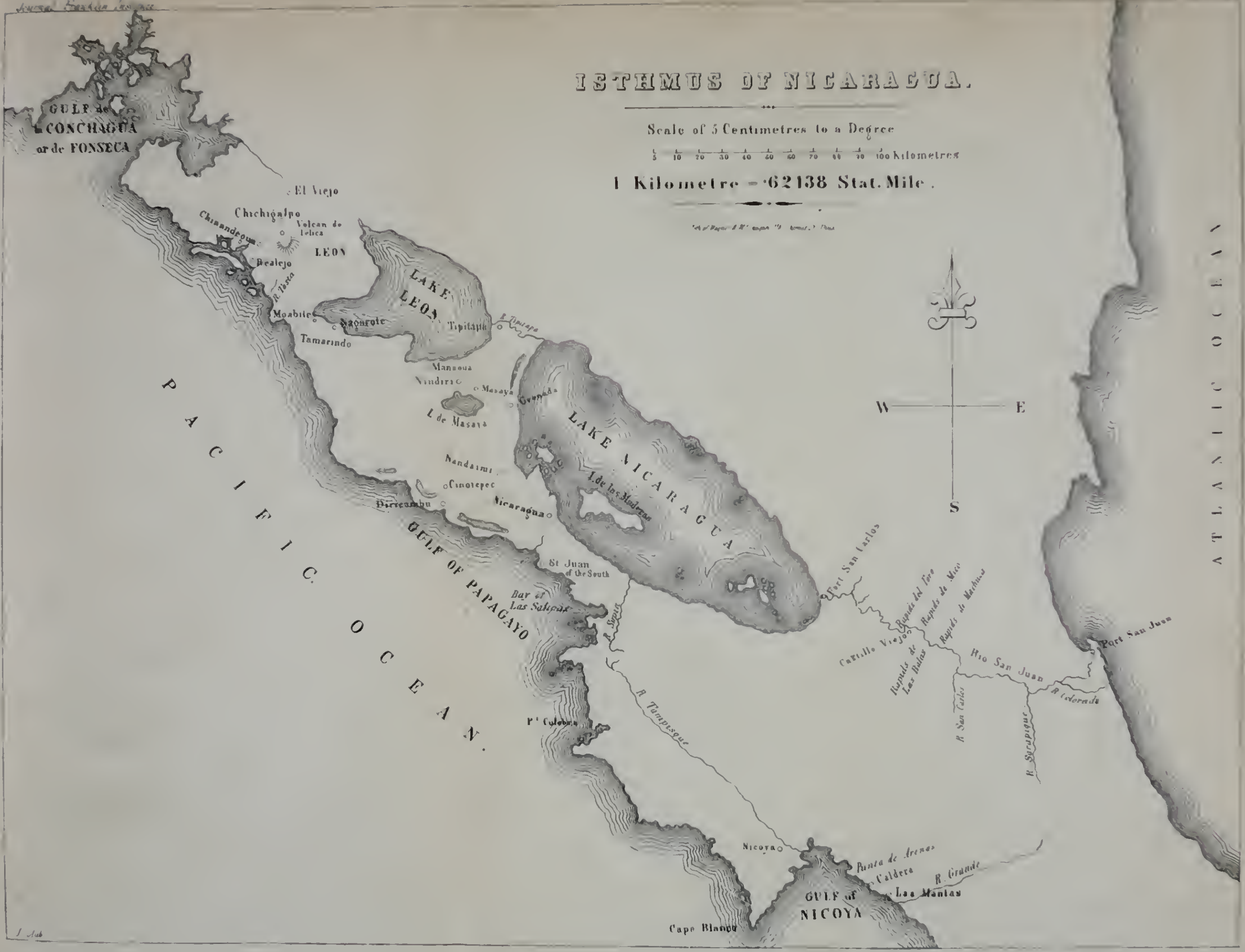

ISTHMUS OF NICARAGUA.

Scale of 5 Centimetres to a Degree

1 Kilometre = ·62138 Stat. Mile.

of San Juan of the South, from the neighborhood of which Mr. Bailey started, and which was naturally indicated by its proximity to the city of Nicaragua,—is it good, or merely tolerable? Some represent it as an open roadstead, others as an excellent anchoring ground. Messrs. Bailey and Stephens, however, who are the latest explorers of this country, agree in speaking well of it. Mr. Stephens found it well sheltered, and Mr. Bailey, who sounded it, reports a great depth of water. It is bordered by perpendicular rocks, to which ships may moor in safety. But it is of limited extent; it is said that twenty vessels would fill it. In 1840, when Mr. Stephens visited it, it was a profound solitude—years had passed that they had not seen a sail. The ports of the gulf of Nicoya, Las Mantas, La Punta de Arenas, and Caldera, appear also to be good harbors. The port of Tamarindo, which is recommended by its great proximity to lake Leon, resembles very much San Juan of the South, according to the statements of those who have a favorable opinion of the latter. But that of Realejo merits our particular attention. Juarros, whom, on this point, no one has contradicted, thus characterizes it:—"There is not, perhaps," says he, "in the whole Spanish monarchy a better port, and in the whole world but few preferable to it. In the first place, it is so vast that a thousand vessels may find shelter in it. The anchorage is excellent throughout, and large ships may approach the quay without running the least risk. The entrance and exit are extremely easy, and no where is there to be met with such an abundance of materials for construction."

We have already seen what is to be thought of the port of San Juan at the mouth of the river of the same name. The works for a communication between the two seas would be reduced, therefore, to a short canal from one of the lakes to the Pacific ocean, and to the canalization of the rivers San Juan and Tipitapa. Nothing would be necessary to put the two extremities of the line of internal navigation in communication with the sea; that will have been already accomplished. The length of the passage from one ocean to the other will be, if terminated on the Pacific at San Juan of the South, 295 kilometres (183·25 miles); if at Tamarindo, 455 (282·50 miles); and if at Realejo, 495 (307·33 miles).

This route presents another advantage not less remarkable, and not less rare in the isthmus. It is, that the most important operations, at least those of the canal to be excavated, from one of the lakes to the Pacific, are to be carried on in a country where laborers are not wanting, and where the diseases which cut off Europeans on the Atlantic shores around the gulf of Mexico, and throughout nearly the whole extent of the isthmus, do not rage. In the supposition, the most natural one, that the canal of junction will commence at Moabita, we have, in the immediate proximity, an abundance of hands. The country, which spreads out between lake Leon and Realejo, offers neighboring centres of population in a greater number than any other portion of the ancient Spanish monarchy in America, within a radius of from 50 to 60 kilometres (31 to 37 miles) around Moabita, and still nearer to the line of the canal; there is Leon, which has 35,000 inhabitants; Chinandega, where we find 16,000; Realejo, Elviejo, and Nazarote, which are all populous. On the southern shore of lake Leon is Managua, with 12,000 souls. Near it, at the north-west extremity of lake Nicaragua, the population is not less abundant. Independently of Grenada and Nicaragua, we may point out Mataya, with 18,000 inhabitants, and Nandaime, which is also of importance. The country, likewise well peopled, is of such fertility that it will be easy to nourish, at small expense, a numerous army of laborers. Messrs. Rouhaud and Dumartray mention tracts that have yielded as many as four crops of maize in a year. When we reflect on the striking beauty of these regions, their riches, and all the privileges which nature has so prodigally bestowed on them, we are led to regard as a presentiment the mystic hope of Columbus, which he has so naively recorded in his letters, that he had discovered the true location of the terrestrial paradise in the countries on which he had landed.

At this time, and for some years back, several individuals of the States of Nicaragua and Costa Rica, supported by their respective governments, have been endeavoring to form a society who will undertake a provisional communication between the two oceans in this direction. Their plan is to throw a barrier across the entrance of the Colorado; then to raise the level of the San Juan de Nicaragua at each of the four rapids above mentioned, so as to have on the river a regular service of steamers, to transport the merchandize, of which the port of San Juan shall be the entrepôt, to Grenada, Nicaragua, and Moabita, at the head of lake Leon. The Tipitapa would be improved in the same manner, by means of dams. The carriage-road from Moabita to Realejo would be put in order and regularly kept up. Magazines would be built at the ports of San Juan, Moabita, and Realejo. It is supposed that a sum of from 12,500,000 to 15,000,000 of francs (2,500,000 to 3,000,000 of dollars) will be sufficient for the undertaking. The persons who are endeavoring to carry out this project, think that it will be a first step towards the establishment of a maritime junction. We cannot deny that facilities of transport, such as will be afforded by steamers from the Atlantic coast into the heart of Central America, will be likely to draw into these happy and almost virgin regions many Europeans, eager in the pursuit of fortune. Central America will then cease to be a land of mystery, and its resources once developed, it will fix the attention of capitalists, and of the governments of the great powers. Moreover, is it not in the order of nature that everything must go on by degrees, and that the commencements of the vastest creations of man are often on the humblest scale ?

[We re-print the following Report of the Western Railroad Company of Massachusetts, which shows the manner in which statistical information is now required by a law of that State to be given in such cases, which is well worthy of imitation elsewhere. COM. PUB.]

Annual Report of the Western Railroad Corporation, for the year 1846.

Return of the Western Railroad, under the Act of April 16, 1846, *for* 11 *months, from Jan.* 1, 1846, *to the* 30*th November*, 1846.

Capital stock,	$3,000,000·00
Increase of capital, since last report,	400,000·00
Capital paid in, per last report,	3,000,000·00
Capital paid in, since last report,	400,000·00
Total amount of capital stock paid in,	3,400,000·00
Funded debt, per last report,	4,999,555 56
Funded debt paid, since last report,	
Funded debt, increase of, since last report,	
Total present amount of funded debt,	4,999,555·56
Floating debt, per last report,	
Floating debt paid, since last report,	
Floating debt, increase of, since last report,	
Total present amount of floating debt,	
Total present amount of funded and floating debt,	4,999·555·56
Average rate of interest per annum on do.,	5·2 per cent.
Cost of Road and Equipment.	
For graduation and masonry, per last report,	3,146,494·36
For graduation and masonry, paid during the past year,	7,545·50
Total amount expended for graduation and masonry,	3,154,039·86
For bridges, per last report,	163,736·23
For bridges, paid during the past year,	
Total amount expended for bridges,	163,736·23
For superstructure, including iron, per last report,	1,031,686·08
For superstructure, including iron, paid during the past year,	22,347·38
Total amount expended for superstructure, including iron,	1,054,033·46
For stations, buildings, and fixtures, as per last report,	232,178·14
For stations, buildings, and fixtures, paid during the past year,	18,153·87
Total amount expended for stations, buildings, and fixtures,	250,332·01
For land, land-damages, and fences, per last report,	234,454·97
For land, land-damages, and fences, paid during the past year,	42,551·19
Total amount expended for land, land-damages, and fences,	277,006·16
For locomotives, per last report,	347,470·72
For locomotives, paid during the past year,	71,507·42
Total amount expended for locomotives,	418,978·14
For passenger and baggage cars, per last report,	50,418·02
For passenger and baggage cars, paid during the past year,	4,648·47
Total amount expended for passenger and baggage cars,	55,066·49

For merchandize cars, per last report,	$ 248,018·41
For merchandize cars, paid during the past year,	122,529·60
Total amount expended for merchandize cars,	370,548·01
For engineering and other expenses, per last report,	665,850·61
For engineering and other expenses, paid during the past year,	
Total amount expended for engineering and other expenses,	665,850·61
Total cost of road and equipment,	6,409,590·97
Cost of Albany and West Stockbridge Railroad, built and leased by Western Railroad,	1,776,197·45

Characteristics of Road.

Length of road,	117·804 miles.
Length of single track,	111·350 miles.
Length of double track,	6·454 miles.
Length of branches owned by the Company, stating whether they have a single or double track,	
Weight of rail per yard in main road,	56·50 lbs.
Weight of rail per yard in branch roads,	
Maximum grade, with its length in main road,	83 ft. per mile, 1·5 miles.
Maximum grade, with its length in branch roads,	
Total rise and fall in main road,	2087 feet.
Total rise and fall in branch roads,	
Shortest radius of curvature, with length of curve in main road,	882 feet; 490 feet in length.
Shortest radius of curvature, with length of curve in branch roads,	
Total degrees of curvature in main road,	6370 feet.
Total degrees of curvature in branch roads,	
Total length of straight line in main road,	62·935 miles.
Total length of straight line in branches,	
Aggregate length of truss bridges,	6092·50 feet.
Whole length of road unfinished on both sides,	

Doings during the Year.

Miles run by passenger trains,	215,369
Miles run by freight trains,	313,259
Miles run by other trains,	45,328
Total miles run,	573,956
Number of passengers carried in the cars,	265,664
Number of passengers carried one mile,	14,273,184
Number of tons of merchandize carried in the cars,	166,394
Number of tons of merchandize carried one mile,	15,748,223
Number of passengers carried one mile, to and from other roads,	7,042,846
Number of tons carried one mile, to and from other roads,	11,275,654
Average rate of speed adopted for passenger trains, including stops,	25 miles per hour, Boston and Springfield. 20 miles per hour, Albany and Springfield.
Average rate of speed adopted for freight trains, including stops,	10 miles per hour.
Estimated weight, in tons, of passenger trains, including engine and tender, but not including passengers, hauled one mile,	9,691,605
Estimated weight of merchandize trains, including engine and tender, but not including freight, hauled one mile,	31,952,418

Expenditures for Working the Road.	
For repairs of Albany and West Stockbridge Railroad,	$11,601·46
For repair of road, maintenance of way, exclusive of wooden truss bridges and renewals of iron,	32,495·54
For repairs of truss bridges, .	11,674·13
For renewals of iron, including laying down,	24,522·12
For wages of switch-men, gate-keepers, and flag-men,	
For removing ice and snow, . .	2,973·94
For repairs of fences, gates, houses for flag-men, gate-keepers, switch-men, tool-houses, .	
Total for maintenance of way, . .	83,267·19
Motive Powers.	
For repairs of locomotives, . .	41,209·25
For new locomotives, to cover depreciation,	7,700·00
For repairs of passenger cars, . .	3,394·31
For new passenger cars, to cover depreciation,	4,750·00
For repairs of merchandize cars, .	21,899·75
For new merchandize cars, to cover depreciation,	10,500·00
For repairs of gravel and other cars, .	
Total for maintenance of motive power,	89,453·31
Miscellaneous.	
For fuel and oil, . .	95,006·01
For salaries, wages, and incidental expenses, chargeable to passenger department, .	22,508·18
For salaries, wages, and incidental expenses, chargeable to freight department, .	63,458·63
For gratuities and damages, . .	7,514·91
For taxes and insurance, .	1,360·49
For ferries, . . .	2,785·17
For repairs of station buildings, aqueducts, fixtures, furniture, . . .	16,195·02
For interest, . .	244,731·57
For amount paid other companies, in tolls for passengers and freight carried on their roads, specifying each company, . .	
For amount paid other companies as rent for use of their roads, specifying each company, .	
For salaries of president, treasurer, superintendent, law expenses, office expenses of the above offices, and all other expenses not included in any of the foregoing items, . .	31,130·89
Income during the Year. [11 months.]	
For passengers:—	389,861·42
1. On the main road exclusively, including branch owned by company, . .	217,064·22
2. To and from other roads, specifying what,	172,797·20
For freight:—	459,365·18
1. On main road and branches owned by company,	156,958·68
2. To and from other connecting roads, .	302,406·50
U. S. mails. Rents, . .	29,191·29
Total income, . . .	878,417·89
Net earnings after deducting expenses,	221,006·52
Dividends. .	204,000·00
Surplus not divided, . .	17,006·52
Surplus last year, . . .	87,005·47
Total surplus, . . .	104,011·99

Estimated Depreciation beyond the Renewals, viz:—
Road and bridges, . .
Buildings, . .
Engines and cars, . . .

ADDISON GILMORE,
EDMUND DWIGHT,
JOHN HOWARD,
JOSIAH STICKNEY,
STEPHEN FAIRBANKS, } *Directors.*
JAMES RUSSELL,
ROBERT CAMPBELL,
JONA. CHAPMAN,
ABRM. H. HOWLAND.

SUFFOLK, ss. *Boston, January* 11, 1847. Then personally appeared the above named Directors of the Western Railroad Corporation, and made oath that the report, by them subscribed, was true, according to the best of their knowledge and belief. Before me,

JOSIAH QUINCY, JR.,
Justice of the Peace.

Railway Statistics.

From the *Eisenbahn-Jahrbuch* (Railway Year-book), recently published by the Baron de Reden, at Berlin, we obtain some valuable additions to railway statistics. The author is now in office under the Prussian Government, and formerly superintended the construction of the railway from Berlin to Stettin.

The analysis of accidents which occurred on railways in Belgium, England, France, and Germany, respectively, during five years, commencing 1st August, 1840, is as follows:—

	Fatal Accidents.	Total number of Accidents.
Belgium,	35	100
England,	300	1500
France,	71	220
Germany,	11	22

It appears, rom this table, that the total number of persons in any way injured during this period, in the four countries, was 1842; and of these accidents, 417, or between one-fourth and one-fifth, were fatal. The following table shows approximately what proportion of these accidents have occurred in each country, and also the annual average of accidents:—

	Fatal Accidents annually.	Total Accidents annually.
Belgium,	7 or $\frac{1}{12}$th	20 or $\frac{1}{18}$th.
England,	60 or $\frac{5}{7}$ths	300 or $\frac{5}{6}$ths.
France,	14·2 or $\frac{1}{6}$th	44 or $\frac{1}{9}$th.
Germany,	2·2 or $\frac{1}{38}$th	4·4 or $\frac{1}{92}$d.

In this table, the casualties on French lines include those of the Versailles catastrophe, by which 55 lives were lost. The accidents on the Belgian lines, in 1843 and 1844, arose almost entirely from breakage of axles and from carriages getting off the rails.

A more accurate estimate of the relative insecurity of railways in either country is obtained by comparing the number of casualties with the total number of passengers conveyed. Taking the annual mean proportion, we get the following results, which distinguish whether the accident arose from the fault of the sufferers or of the railway managers:—

	Passengers killed from their own neglect.	Officials killed and wounded from their own neglect.	Persons killed from defective management.
Belgium,	1 in 670,000	1 in 280,000	1 in 1,690,764
England,	1 in 869,000	1 in 300,000	1 in 852,416
France,	1 in 2,157,000	1 in 5,000,000	1 in 3,465,996
Germany,	1 in 25,000,000	1 in 9,000,000	1 in 12,252,858

In this list, each country is placed in the order of the relative insecurity of its railways. The terrible disproportion in this respect, between the two former and the two latter, is very significant, and deserves careful attention. Civ. Eng. & Arch. Jour.

Notice of a Paper on the Helder or Great North Holland Canal, read before the Institution of Civil Engineers, by Mr. G. B. W. Jackson, Associate, *Feb.* 9, 1847.

This canal was constructed by the late Mr. J. Blanken, engineer, during the six years between 1819 and 1825, for the passage of frigates and first-class merchantmen, and extends from Amsterdam to Nieuwediep in the Texel. The state of the navigation through the Zuyder Sea, in the early part of the 17th century, having become so defective, in consequence of accumulated sand-banks and shoals, that camels were necessarily made use of to lift the vessel over the shallows at Pampas, thereby incurring both extreme loss of time and inconvenience, the Dutch Government deemed it necessary to consult Mr. Blanken on the possibility of remedying the evil. That engineer accordingly projected the above canal, which has three divisions, the summit level being only three feet eight inches above the outlets. Its length is fifty-one miles. It is one hundred and twenty-three feet seven inches broad at top, thirty feet ten inches at bottom, and twenty feet six inches deep. The pile-driving and boring experiment undertaken by him, to ascertain the probability of success, show that the original sea-shore, being the only really hard ground in the north of Holland, is to be met with at forty-three feet under the present surface of the ground; and as the foundations of the locks were laid nearly at that depth, the result of the experiment was considered to afford sufficient guarantee for the stability of the works. The character of the soil in that part of Holland is exceedingly treacherous, and it reflects great credit on our foreign neighbors that they were able to overcome the various difficulties with which they had to contend.

The constructions generally consist of floating and swing-bridges, tide-locks, passage-locks, &c. The floating bridges are peculiar on account of their flexibility, consisting of two platforms, one fixed to each shore, on piles, the end of each of which is worked by sets of double levers, and resting on two boats, so that when the bridge is required to be opened, both boats are withdrawn, one towards each shore. The Willem lock is two hundred and ninety-seven feet eight inches long, fifty-one feet five inches wide; the height of the lock walls being thirty-two feet six inches, and the gates being each twenty-nine feet five inches by twenty-nine feet four inches.

The total cost amounted to one million and a half pounds sterling. The time required by vessels to make the passage from Amsterdam to the Helder varies according to their size, and the means of haulage; fly-boats with six relay of four horses each, making it in ten hours, whilst large east Indiamen require two, three, and four days, according to the wind. The details of construction of the whole of the works were given very freely and with illustrated drawings. In the discussion which ensued, it was stated that the only canal in this country which could be contrasted with that of the Helder, was the Caledonian canal, which was projected upon a report by Watt, commenced by Jessop, and in a great part constructed by Telford, a few years previously to the Helder canal. The principal difference between the two consisted in the nature of the ground through which they were cut, the former being excavated entirely out of alluvial deposit, whilst the latter had to be cut out of hard gravel, and in some cases rock. An interesting account was given of the mode of forming the spot for the entrance lock at the Inverness end of the Caledonian canal. The object was to carry the work out into deep water. A large mass of earth was deposited in the sea to the full extent intended. Upon this mound a heavy load of material was laid, to consolidate the mass. After settling for a considerable time, the upper mass was removed, the excavation was made for the lock-pit, and the construction was effected with comparative facility, and had endured much rough weather since, without any symptoms of failure. The superincumbent weight which was removed being greater than any subsequent strain, there was no danger of the lock ever sinking.

On the 16th inst., this paper was continued, and treated principally of the art of building with fascine work, as practised in Holland and Germany.

The usual construction of these dykes was described to be, by sinking successive layers or beds of fascines, or faggots, of almost thirty inches thick by from eight to sixteen yards in width, and of proportionate length, weighted with gravel and stones, mingled with clay, sea-weed, and silt. These layers were continued until they reached above the sea level, when the top was constructed of more solid materials, and sometimes capped with brickwork, as the public roads were formed upon them.

The slopes of the faces of the dykes vary considerably: some of the low dykes are in section of the form of an arc of a circle of six to ten feet chord and ten inches to one foot versed sine, covered with fascine matting, staked down upon a clay-bed. Others have a base of nineteen feet wide and five feet of a triangular section, also made up of fascines and stakes, secured by hurdles and wattling, with clay, peat, sea-shells, and sand, well rammed in, and then covered with turf. Others are formed with rows of piles, sixteen feet long, with their heads six or seven feet above the shore, joined longitudinally and laterally, by waling timber, filled in and around with fascine beds and weighted with stone. Baskets filled with sand are also used in certain situations, as well as various modifications of all these kinds of protections. It was stated that these constructions were found to succeed better, and last as long as stone, being at the same time about half the cost.

Ibid.

Protracted Progress of the Railway System.

Had it not been for the force of prejudice, we might have had the railway system in active operation at a much earlier date, and that even in its present form; it was but the chance votes of one or two directors that secured its advancement in 1829. All the main lines of railway now existing were projected in 1824 and 1825, and might have been executed before 1830, instead of lingering till nearly the present day; public and legislative ignorance, however, stood in the way, and it cannot be denied that the country has thereby been kept back for many years in its prosperity and advancement. To show more fully the operation of the retarding force of prejudice, we shall give the dates of many railway inventions and the dates of their recognized use :—

1754, flanched wheels,	adopted	1815
1789, edge rails,	"	1815
1803, malleable iron rails,	"	1830
1820, parallel rails,	"	1835
1804, locomotive engines,	"	1821
1805, ditto for passengers,	"	1830

In 1804, we had malleable iron rails, flanch wheels, and the locomotive. We had, in fact, all the elements of the railway system; and had they then been fully adopted, their development must have been much more rapid than it has since been. In 1814, a speed of 20 miles an hour would have been gained by George Stephenson, and we should be at least 20 years in advance. Every part of the system has, however, been kept back by errors and prejudice; and the exertions of Richard Trevithick and George Stephenson retarded by the ignorance and want of reasoning power of their professional brethren. No theorem can be proved more effectually than that the railway system of 1825–1835 might have been carried out in 1805–1815, and it presents one of the clearest cases to be found in economical history of the prejudicial postponement of a valuable institution.—*Railway Register.*

Lond. Mining Jour.

Iron Bridge Rails.

We understand that Mr. Wood, of the British Iron Company's Works, Abersychan, succeeded in rolling, during last week, bridge rails weighing 90 lbs. per yard, 30 feet long; and finer and more perfect rails, a correspondent asserts, were never seen. This is but one of the many instances in which Mr. Wood has proved his great skill and extensive practical knowledge of the manufacture of rails and other iron, as well as the *minutiæ* of the iron manufacture generally —as the workings for which this establishment is celebrated fully testify. Ibid.

AMERICAN PATENTS.

List of American Patents which issued in the month of May, 1846,—*with Exemplifications, by* Charles M. Keller, *Agent for procuring Patents, and late Chief Examiner of Patents in the U. S. Patent Office.*

1. For *Improvements in the Plough;* John M. May, Philadelphia, Pennsylvania, May 2.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the land-side, the bed of the share, and the standard all in one piece of sheet-metal, cut out in the manner described, so as to afford greater stability, and to reduce the cost of construction.

"I also claim making the coulter with two points and two cutting edges, and secured to the land-side of the standard, to admit of reversing end for end, and inclining the forward point up or down, for the purpose and in the manner described.

"And, finally, I claim connecting the axletree of the guide-wheels with the beam, by means of adjustable arms, to afford a means of directing the plough, as described."

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2. For an *Improvement in the Lamp for burning Lard and Oils;* John Street, Philadelphia, Pennsylvania, May 2.

This is for making the stand and the bowl of the lamp of wood, the latter being lined inside with metal; and for this purpose, the bowl, or oil receiver, is made in two parts, to admit the metal lining; the two parts of wood being then secured in any desired manner by screwing them into one another, by means of flanches.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing the lamp, by making the stand and base of wood, and the bowl of wood lined with metal, as described in the specification and drawings."

3. For an *Improvement in the Machine for Bolting Flour;* Elisha S. Snyder, Charlestown, Jefferson county, Virginia, May 2.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the before described improvement in the machine for bolting flour, that is to say: The combination of the bran trough, elevator, and spouts with the contrary conveyor and spouts for separating the finished flour from the middlings, and conducting the flour to the discharged spout by the contrary conveyor, and the latter to the meal chest, through the openings, whence it is again elevated by the elevators and subjected to another operation in the revolving sieve; whilst the bran is at the same time mixed with the middlings and flour, being first received into the trough, and elevated thence, by the additional elevators, to the spout which conducts it to the meal chest, by means of another spout, where it is mixed with the middlings and flour, and elevated to the sieve by the elevators, by which the bran is made to repeat its office of keeping the meshes of the bolting cloth open, as described."

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4. For an *Improvement in the Wind Mill;* Allen Judd, Cabotsville, Massachusetts, May 2.

This invention consists in placing the vanes around a vertical shaft, and at a distance therefrom, and arranged with their planes tangential to the inner circumference of the rims of the wheel to which they are attached, or to some circle of less diameter, with sufficient space between each for the passage of the wind, which enters the wheel from below, and acts on the inner surfaces of all the vanes and passes out; the wheel being surrounded with two series of shutters, or blinds, one series below a floor which is on a level with the lower open rim of the wheel, and the other series above this floor, the former being thrown open on the side towards the wind, by which it enters the wheel, and those of the upper story thrown open on the other side, for the escape of the wind after it has acted on the wheel.

Claim.—"I claim as my invention, and desire to secure by letters patent, a wheel, substantially such as is herein described, having one end open for the admission of the wind, in combination with a surrounding casing, divided into two compartments and composed of shutters, one of the compartments to admit the wind to the inside of the wheel, and the other to permit its escape, all substantially as herein described."

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5. For a *Guard for preventing the passage of Air and Water under Doors;* Luther Gifford, Syracuse, New York, May 2.

Claim.—"I do not claim a flap, hinged to the bottom part of a door, or operating in vertical directions in a groove, or cavity, made therein, as heretofore used and applied to doors; but that which I do claim as my improvement, is the combination of the turning flap (applied to the door) and the shoulder made upon the threshold thereof; the said turning flap having a spring or equivalent adapted to it and the door, for turning it, and elevating or partially revolving its lower edge above the threshold, while the operation of opening the door is being effected; and also a cam-plate, or other mechanical equivalent, applied to the door-frame, for the purpose of turning it (the flap) into a vertical position whenever the door is closed, as described."

6. For *Improvements in the Plough;* John M. May, Philadelphia, Pennsylvania, May 2.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the making the land-side, the mould-board, and posts of ploughs all of one piece of plate-metal, as described; thereby saving much expense in making, and being more firm and substantial than when made of separate pieces.

"I also claim the adaptation of a guard superficially applied to finished ploughs, as described; thereby adding to their durability, by protecting the parts most liable to wear—when removed leaving that part of the plough as perfect as when new—and which may be used or omitted at pleasure.

"I also claim the method of attaching and securing the movable progressive share, by means of the belts passing down below the mould-board, in combination with the notches in the back edge of the share, substantially as described; thereby saving (when this form of plough is used) the great expense of shares, as one progressive share equals, in service, several of the ordinary kinds.

"And, finally, I claim the method of fastening and adjusting the coulter, as described; thereby presenting, successively, a great length of cutting edge to sever obstructions before the plough."

7. For a *Machine for Cutting Shell or Horn;* Joel R. Morse, Boston, Massachusetts, May 2.

After the shell or horn has been properly softened, it is put on to a carriage which carries it to, and against, the edge of a knive, by which it is reduced to the required thickness; and to hold it on to the carriage, with the face in contact therewith, notwithstanding the inequalities thereof, a thin, flexible plate of metal, attached to the carriage, is placed over the shell or horn, and over this another thin plate of metal, which does not move; and this last plate is borne down by a series of vertical pressers, forced down each by a separate spring, to act on the unequal surface of the shell or horn, and thus make one surface level with the surface of the carriage, so that the knife shall only shave off the surplus thickness.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement for carrying the shell to the knife, upon a carriage, in connexion with the method of holding the shell steadily upon the carriage, by means of the disconnected upright bearings, operated upon by the springs, as herein described."

8. For *an Improvement in the Sash Fastener;* Wm. S. McLean, Allegheny, Pennsylvania, May 2.

A cog-wheel is placed in the window frame, so as to act on the sash, and on the arber of this wheel there is a ratchet-wheel, the teeth of which, on the face of the cog-wheel, receive a spring-catch, and the ratchet-wheel is prevented from turning too freely by a friction spring, so that when the cog-wheel is unlocked, by withdrawing a spring-bolt, the sash can be moved up or down, the friction spring on the periphery of the ratchet-wheel being sufficient to hold the sash in any desired position.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the cog-wheel, friction ratchet-wheel, friction spring and lock-bolt, as applied to window-sash, in the manner described."

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9. For an *Improved Apparatus for Washing and Amalgamating Gold and Silver;* Daniel Asbury, Coburus P. O., Union county, North Carolina, May 2.

The patentee says,—"By the ordinary and common processes for the separation of gold and silver from their ores, by washing with water and amalgamation with mercury, there has always been a loss of both gold and silver, as well as of the mercury. In the hand rocker and long semi-circular trough, usually worked by hand, the quantity of sand and gravel which these machines can work is small, consequently, when that contains but little gold or platinum, it cannot be worked with profit; and in these machines there is a great loss of both gold and platinum, as well as quicksilver, (when that is used,) because the motion is half the time in one direction, and half the time in the other, by which the gold, &c. is prevented from subsiding, and consequently passes off with the water and sand. In the Burke rocker, there is a still greater waste of quicksilver and the precious metals. In the Tyrolese bowls, the sand and gravel subside too soon to the bottom, and prevent the contact of the gold and silver with the quicksilver. My machine, I believe, will obviate all these practical evils, which, heretofore, have attended the extraction of the precious metals from their ores, or earthy and stony mixtures; these objects I effect in the following way:—

"The moving frame, which supports the pans, is hung to two cranks on two shafts, one at each end, by the rotation of which, the required shaking motion, such as would be given by hand, is obtained."

Claim.—"Having thus fully described my improved apparatus, what I claim as my invention, and desire to secure by letters patent, is the moving frame supporting one or more pans, and moved by cranks, or other analogous device, causing them to be shaken, in the manner and for the purpose above set forth."

10. For an *Improvement in Overshoes;* Andrew Vetter, Philadelphia, Pennsylvania, May 2.

Claim.—"Having thus fully described the manner in which I form my *elastic spring shank overshoe*, I do hereby declare that I do not make any claim to the employment of strands or strips of India rubber, or of spiral springs of metal, in the quarters, or in other parts of the uppers of shoes; but what I do claim as new, and desire to secure by letters patent, is the forming of the shanks, and that part of the quarters which are commensurate therewith, of upper leather, between which and the lining, elastic strands or strips of India rubber, or spiral springs of metal, or both conjoined, are inserted and extended along, for the purpose and in the manner fully made known.

"I also claim the manner of forming a hollow heel in overshoes, by inserting a hollow metallic box, duly formed, between the two thicknesses of leather, constituting a part of such hollow heel, as described and represented."

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11. *For a Composition for Blacking;* Jos. Hayward, Cleveland, Ohio, May 9.

Claim.—"Having thus fully described my improved blacking, I wish it to be understood that I do not claim as my improvement the employment of soap in the manufacture of blacking, as that has already been done, nor the combining therewith lampblack; but what I do claim as my invention, and desire to secure by letters patent, is the combination of lampblack with an alkali, as set forth, before combining therewith the compound of potash, tallow, and oil, in the manner and for the purpose set forth, by which a smooth and durable blacking is produced."

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12. For an *Improvement in the Method of Tuning the Metallic Reeds of Seraphinas, Accordeons, &c.;* J. Shaler Ives, New York city, New York, May 9.

The patentee says,—"The object of my improvement is to simplify and cheapen the construction, and to provide means for the adjustment of the reeds, to make them 'speak;' these ends I attain by making the reeds, which are attached to the bottom of their appropriate plates, to spring up through the apertures in which they vibrate, so that, by the application of an adjustable pressure above them, their plane can be regulated relatively to the apertures with the greatest nicety, to insure their speaking and giving out the best tones, the vibration being insured for a good tone by the pressure of the spring of the reed against the presser."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is tuning metallic reeds that vibrate within the apertures for the passage of the wind, by means of adjustable pressers that act against the spring of the reeds, substantially as described.

"I also claim making the slide with the parallel spring bars or branches, substantially as described, to insure the working of the slide without being affected by the vibration of the reed, as described.

"And I also claim making the pressure on the top of the reed, by an adjusting screw, or other analogous device, to regulate the speaking of the reed, as described."

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13. For an *Improvement in the Shovel Plough;* Moses D. Wells, Morgantown, Virginia, May 9.

The improvement here claimed is for inserting a rudder, that is, a piece of iron which projects back from the shovel of the plough, and extending down some distance below the point, to answer the purpose of a guide, to prevent the plough from deviating from the true course.

Claim.—"What I claim as my improvement, is the constructing the shovel plough with a rudder arranged in the manner described."

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14. For *Improvements in Bee Hives;* Wm. R. Kelsay, Starkey, Yates county, New York, May 9.

Claim.—"Having thus fully described the manner in which I construct, arrange, and use my combined tiers of hives, what I claim as new therein, and desire to secure by letters patent, is the manner of arranging the respective tiers of boxes, so that the upper one of each tier may be removed, and the two lowermost may be elevated and held in place, by means of the sliding rods, for the purpose of introducing an empty hive beneath them, in the manner and for the purpose set forth.

"I do not claim the arranging of the boxes in tiers one above the other, and the forming of passages between these boxes, but limit my claim to the particular combination of parts, by which this combination is rendered effective in attaining the proposed end in the manner described.

"I likewise claim the forming of a compartment below the hives, surrounded entirely by stone, or metal, and so arranged, as described, as to induce the bee moth to deposite its eggs in such compartment, where they necessarily perish, and the bees are consequently protected from this formidable enemy."

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15. For *Protecting Bees from the Moth, called "A Cloth Moth Harbor;"* Daniel Arndt, West Middletown, Pennsylvania, May 9.

This consists of an apartment lined with cloth, which the moth enters, and in which it remains, (attracted by the warmth of the cloth,) instead of passing into the hive.

Claim.—"What I claim as new, and as my invention and discovery, in the above described apparatus, and for which I ask exclusive privilege by letters patent of the United States, is the cloth moth harbor, for protecting the bees and their labors from the ravages of the moth, the moth being induced, through the warmth of the cloth lining, to deposite its eggs therein, instead of in the hive."

16. For a *Method of Propelling Boats, Railroad Cars, &c.;* Josephus Echols, Columbus, Georgia, May 9.

The patentee says,—"The object contemplated by me in this invention is to economize the power required for propelling boats, or other vessels, by making use of the resistance which the water presents to the bow of the boat in its passage, and causing it, (the water,) when being deflected, to turn a wheel which is in connexion with the paddle-wheel shaft, and thus assist the driving power, such as a steam engine, in propelling the boat. With the view to attain this end, extra water wheels have been placed at the sides of the vessels, and connected with the paddle wheels, so that the current of water set in motion by the paddle wheels should communicate motion to the extra wheels, which, by the connexion, transfer the power to the paddle wheels; but it must be obvious that this arrangement occasions an actual loss of power, for the motion communicated to the extra wheels at the sides retards the boat by a force equal to that communicated to them, minus the friction. But by placing the compensating wheel at the bow, where the water must be displaced by the bow of the boat, the deflexion of the water communicates available power to the wheel, which may be advantageously employed to aid in the propulsion of the boat, or applied to any other purpose."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of a wheel, or wheels, at the bow of a boat, to be driven by the resistance of the water as the boat is forced through it, for the purpose of aiding in driving the paddle wheels, and thereby saving power, as described; or to be applied as a moving force for any other purpose on the boat, as described."

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17. For an *Apparatus for Preserving Corpses;* Robt. Frederick & G. A. Trump, Baltimore, Maryland, May 9.

The patentees say,—"Various devices have from time to time been essayed for preserving bodies after death, by the application of ice; but where applied directly to the body it was troublesome and ineffectual, wetting it, and thereby rendering it more subject to decomposition. Another process has been, to place the body in a coffin-shaped case, said case being surrounded with ice, but this method is objectionable, on account of the space that must intervene between the ice and those parts of the body most desirable to congeal. Experience has proved that it is only necessary to freeze the trunk, or abdomen, and the chest; but no apparatus has heretofore been made that would, with any degree of certainty, effect this object on all sized persons, without an immense expenditure of ice, owing to the difficulty of bringing the reservoir containing the ice in contact with the proper parts. By our invention, we effect this, and, with a very small quantity of ice, we freeze the corpse as much as is necessary, while, at the same time, our apparatus is portable and convenient."

Claim.—"Having thus fully described our improved apparatus and its application, what we claim as our invention, and desire to secure by letters patent, is a reservoir for containing ice, having a bottom formed to fit the corpse, so that it can be placed in contact with it, in the manner and for the purpose described."

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18. For an *Improved Mode of Making Spoons, Ladles, Knives, Forks, &c.;* Walter W. Hart, Philadelphia, Pennsylvania, May 9.

The patentee says,—"The nature of my invention consists in manufacturing spoons, ladles, knives, forks, sugar-tongs, and other like articles from silver, or other malleable metals, by means of swedging, or raising, metal (which has been rolled to a uniform thickness) from a level, even surface, to an uneven surface, that the parts which are made prominent may be cut off. All the parts of the metal which are required to be made more or less thin, must be more or less raised; the more it is raised, the thinner it can be cut without cutting those parts which are intended to be left of a full thickness. The metal which is to be operated upon should be made of the same thickness as the thickest part of the spoon or other articles to be manufactured, and all the parts of the metal that is necessary to be taken off, to make it of a desirable thickness, must be forced above the common level surface, or above those parts which are to be left of a full thickness. The object of it is to raise up and cut off all those parts of the spoon (or other article to be manufactured) which, in the usual methods, are hammered thin."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the forming of spoons from plate blanks, by first striking up that part of the blank which is to form the bowl, as described, then planing off the convex side until it becomes flat, or nearly so, and finally subjecting the blank thus prepared to properly formed dies for giving shape to the spoon, all substantially as set forth."

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19. For an *Improved Turn-key for Drawing Teeth;* Hiram Todd, Columbus, Ohio, May 9.

Claim.—"What I claim as my invention, and desire to secure by letters patent, are the following combinations of the parts of the instrument:

"The controlling of the hook with the lever, by means of the rack, pinion and socket, spindle, and cylinder, as described and set forth in the accompanying drawings and specifications."

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20. For an *Improvement in the Machine for Cutting Meat;* Abisha Clark, Doe Run, Chester county, Pennsylvania, May 9.

A series of double-edged knives are attached to a frame that vibrates within a case provided with a series of knives on opposite sides, against which they alternately cut.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is a series of knives moving from side to side of a square box, or tube, as herein set forth, having stationary knives to play between, in the manner and for the purpose set forth."

21. For an *Improvement in Fastenings for Bedsteads;* John Haslet & Cornelius Devitt, Irville, Ohio, May 9.

The patentees say,—"The nature of our invention consists in connecting the rails with each other with mitre joints, which embrace a round or square part of the posts which are notched, or grooved, to receive the mitred joints of the rails, the whole being then secured by a pin for each post, which passes through the two rails at their junction, and through that part of the post embraced by the mitre joint; the said pin being parallel with one of the rails, and therefore crossing the mitre at an angle of forty-five degrees; and that part of the post embraced by the rails, if square, having two of its sides parallel with the mitre joint, and the other two at right angles thereto, so that when the whole is put together, and the pin inserted, they cannot be separated without previously removing the pin; for the rails cannot be separated from the post except by drawing them in a line at right angles with the mitre, and this would necessarily break the pin which crosses this line at an angle of forty-five degrees; and the same thing will take place if that part of the post which is embraced by the rails be round, although in a manner not so effectual as if made square."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the method of fastening and holding together the rails and posts of bedsteads, by means of the mitre joints of the rails let into and embracing the posts, in the manner herein described, in combination with the screws, or other fastenings, inserted in a line parallel with one of the rails, and that part of the post embraced by the mitre being either round, or square, or nearly so; and, if square, the faces being at right angles to, and parallel with, the mitre, for the purpose and in the manner herein described."

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22. For a *Machine for making Harnesses;* Samuel Wilson, Dansville, New York, May 9.

This machine is for the "purpose of edging, creasing, buffing or shaving, ovaling, rounding or forming, and pricking leather straps, and particularly for tugs."

Claim.—"I claim the manner of making the metallic bed by which the leather bed is supported, viz: in two parts, one of which is made capable of being elevated and depressed by an adjusting screw, and acting in connexion with the other as an apparatus for shaving or reducing the projecting edges or parts of the leather, as described, the metallic bed serving the double purpose of a rest for the false leather bed, and a plane, or shave, to act upon the leather, as described.

"I also claim the combination of a false leather bed with a stationary solid bed and stationary roll, or other substitute therefor, for channeling and shaping the leather, as specified.

"I also claim the combining with the bed-piece the series of adjustable jaws, or holders, which perform the double purpose of holding in place a leather bed of any required size, and of serving as guides for the passage of the strip of leather over the bed, as before explained."

23. For a *Machine for Shaving and Jointing Staves, for Barrels, &c.;* John H. Lester, New London, Connecticut, May 9.

The patentee says,—"The dressing and jointing on rived staves by machinery are operations which have heretofore presented much difficulty, and of the various attempts to attain these important ends, by means of rotating planes, none has, so far as I am informed, been successful. The difficulty arises from the fact of the uneven and crooked condition of the rived bolts, which must be dressed with the grain of the wood, and of equal thickness, and the necessity of jointing the curved edges of the staves, to give the bulge to the barrel, or cask, by a continuous movement. The dressing of staves has been essayed by two rotating planes—one to plane, or dress, the concave, and the other the convex, surface; the planes being placed one forward of the other, so that the staves pass from the one to the other; but in this there is no method by which the planes can adapt themselves to the bends and crooks of the bolts. Attempts have also been made to joint the edges with rotating planes, by placing the stave, after being dressed, on a reciprocating carriage, provided with guides to cause the rotating planes to approach towards, and recede from, each other, to give the required bulge to the staves.

"The improvements which I have made, and which I wish to secure by letters patent, remove these difficulties, and consist, first, in hanging the two rotating planes, one above the other, in a vertically sliding frame, to receive the bolt from the feeding or guide and pressure rollers, and pass them to other rollers, which deliver or conduct them to the jointing operation, the frames sliding up and down, to adapt the planes to the bends, or crooks, of the bolts, the sliding of this frame being effected by two sets of rollers hung in the frame, one forward, and the other back, of the rotating planes; and, second, in giving to the frames, in which the jointing cutter heads are hung, and run, reciprocating movements towards and from each other, by means of cam-grooves, eccentrics, cranks, or other analogous device, as the staves are fed forward by a positive motion; the continuous feeding and reciprocating motion of the cutter-heads being made to correspond."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is hanging the two rotating planes in a vertical frame, which slides freely up and down, to adapt the planes to the crooks and bends of the wood, as herein described. I claim the employment of the two sets of rollers, or either of them, running in the vertically sliding frame, in combination with the rotating planes, for the purpose of guiding the rotating planes, and adapting them to the dressing of crooked or bent staves, as herein described.

"I claim, in combination with the rotating planes, the arrangement of the three sets of rollers that guide and conduct the bolt to the rollers and rotating planes in the sliding frame, the set nearest the sliding frame having the preponderance of the one that first receives the bolt, as described, for the purpose of properly adapting the crooked or bent bolts to the action of the planes, as described.

"I claim giving to the cutter-heads, for jointing the staves, a reciprocating movement towards and from each other, in combination with the continuous feeding in, and movement of, the staves through the machine, as described.

"And, finally, I claim the employment of the elliptical or eccentric guide rollers, in combination with the cutter-heads, as herein described."

24. For *Improvements in Railroad Switches;* Philos B. Tyler, New Orleans, Louisiana, May 9.

The patentee says,—"The nature of my invention consists in constructing the movable part of the switch with an additional branch rail, between which and the true switch, there is an inclined plane and a guard on the outside, so that when the switch is set wrong the cars cannot run off the track."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of the switch as herein described, that is to say, the addition of the branch to the main rail, with the inclined plane for the flanch of the wheel to run upon between them, and, in combination therewith, the short rails and guard, arranged substantially in the manner and for the purpose above set forth."

25. For an *Improvement in the Machine for Cleaning Wheat, &c.;* J. W. Howlet & F. M. Walker, Greensborough, North Carolina, May 9.

This machine consists of two circular disks, the upper one stationary, and the other a runner, similar to the runner of a mill. The stationary disk has two concentric rings projecting from its upper surface, and an outer rim, the surfaces of which are ribbed; and between these play wedge-formed, fluted rubbers, that act upon the grain. The two rings have openings in them, for the passage of the grain as it is carried by the rubbers from the centre to the periphery, where it is discharged through two spouts in the outer rim. The spouts are made in radial arms projecting from the periphery of the runner, and to the upper surface of these, projecting oblique beaters, which carry the grain around in a drum which surrounds the machine.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the revolving and stationary disks, with the rubbers, and rings, and rim, combined and operating with each other; and, in combination therewith, the arms and beaters, substantially in the manner and for the purpose herein set forth."

26. For an *Improvement in the manner of Applying Water to Water Wheels;* J. K. Millard, Town Hill, Pennsylvania, May 9.

This is for a mode of regulating the discharge of water on to that class of water wheels, formerly known as "tub wheels," but now sometimes called "turbine wheels." The flume, which is vertical, has a bottom just above the top of the wheels, and in this there is an annular opening corresponding with the circle of the buckets of the wheel. In this groove are hinged a series of shutters, which are suspended to a ring, which, when let down, covers entirely the annular aperture, so that, when this is raised or lowered, the shutters are opened or closed, and therefore the general aperture is regulated in proportion to the separate apertures formed by the series of shutters.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the series of shutters to regulate and direct the discharge of the water on to the buckets of the wheel, in combination with the gate to which they are suspended, and by which they are operated and protected from the too violent action of the water; this gate at the same time affording a better means of shutting off the water than could be effected practically by the shutters, as described."

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27. For an *Improvement in Pickers for Looms;* Benj. A. Holbrook, Providence, Rhode Island, May 9.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method, as fully described, of fastening raw hide pickers, by means of a rivet at the junction of the bow and stem, which has the heads all on one side, that side of the stem towards the bow being straight from end to end; when this is combined with a rivet, or other equivalent fastening, at the end of the stem, for the purpose and in the manner substantially as described."

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28. For an *Improvement in Reverberatory Furnaces for Smelting Iron;* Andrew Ellicott & John McCrove, Baltimore, Maryland, May 16.

This is for an improvement in furnaces for reducing iron ores, whose object is to facilitate and economize fuel. Two stacks are placed side by side, with a blast for each, which, as occasion requires, may be diverted in such a manner that nearly the whole blast may be directed to one of the stacks, while the charge in the other preserves sufficient heat for its stage of the process. It is believed that extracts from the patent are unnecessary.

Claim.—"Having thus fully described the manner in which we construct our double hot-blast reversing furnace, and shown the design and operation thereof, what we claim therein as new, and desire to secure by letters patent, is the manner, herein made known, of combining two reverberating chambers with a single fire chamber, under an arrangement by which we are enabled, when necessary, to direct the whole of the double blast into either of the reverberating chambers at pleasure, for the purpose set forth.

"We also claim the particular manner in which we form, arrange, and apply the hollow grate bars, and the trunk, or tube, through which they are supplied with cold air, by which arrangement, all that is necessary to insure their proper action is simply the dropping them in place side by side, as herein made known."

29. For an *Improved Hot-air Back, for Cooking Ranges;* H. H. Stimpson, Boston, Massachusetts, May 16.

Claim.—"I am aware that the fire-backs of fireplaces have been made separate, to admit of removing them when burnt out; but I am not aware that that part of the front plate of the air chamber of a range which constitutes the fire-back has been made separate from, and to cover, the hole in the front plate of the air chamber, which is cast in one piece, with the ends and part of the top and bottom.

"It will be obvious that a different result is attained by this arrangement, for the fire-back, as heretofore made, is attached all around to the fireplace, so that when the middle, which is subjected to the greatest range of heat, expands and contracts, the plate is much strained, and necessarily cracks in the middle, or opens at the joints; results entirely avoided by my improvement. I do not, therefore, claim simply making the fire-back of a separate plate, for this would not attain the end contemplated; but what I do claim as my invention, and desire to secure by letters patent, is making that part of the front and top plate of the air chamber which constitutes the fire-back separate from, and attached to, the front plate of an air chamber, cast with the ends, top, and bottom, substantially in the manner and for the purpose specified."

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30. For an *Improvement in Water Wheels;* Christopher Hand, Port Elizabeth, New Jersey, May 16.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of buckets hinged on the edge next the soling, in combination with a wheel having rims projecting from the periphery, to confine the water to the buckets, as described. And I also claim providing such a wheel with scoops, for the purpose of discharging such water as may leak through, as described."

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31. For an *Apparatus for the Cure of Spinal Diseases;* John L. Sullivan, New York, May 16, 1846, antedated November 17, 1845.

This apparatus consists of a metal strap, (hinged at the back,) that passes around the lower part of the body, just above the hips, connected, by diagonal braces, with shoulder straps, and with a windlass which lies vertically along the back, by the turning of which, a chest belt is drawn tight, or loosened, at pleasure. The lower belt is connected with the chest belt by means of levers, or braces, and with the windlass by a screw, the turning of which will either depress or elevate the windlass and its connexions. By this combination and arrangement of parts, it is declared that any part of the body can be sustained at pleasure.

Claim.—"What I claim as my invention in said machine, is the combination together of all the parts following, viz: the combination of the said windlass and its lever recipient of the force; the internal screw of said windlass, and the levers on which the said male screw bears; the combination of the said side levers themselves; the chest belt, the windlass and its fastenings, and the belt and spring around the shoulder, and the mode of working the same together; the same being constructed substantially as aforesaid, whereby the curvative force, acting and reacting, as aforesaid, is applied substantially to cure the disease, as aforesaid; by which I effect the combined action of reducing the curvature, and, at the same time, the lifting of the chest, to make room for the reduction thereof."

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32. For an *Improvement in Sugar Pans, for Evaporating Saccharine Juices, &c.;* Alfred Stillman, New York, May 16.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is dividing the main pipe into two parts by a cross partition, in combination with the bent branch tubes that connect each with two divisions of the main pipe, as described, for the condensation of the steam.

"I also claim connecting the main pipe with the sides of the pan, and with the induction and eduction pipes, by means of the double stuffing boxes on each, as described, to admit of the turning of the main pipe, as described; and, finally, I claim the method of connecting the branch pipe with the main pipe, by means of socket joints, as described, in combination with the mode of securing them by means of screws passing through the main pipe and tapped into tubular nuts in, and connected with, the ends of the branch pipes by wings, for the purpose and in the manner herein described."

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33. For *Improvements in Cooking Stoves;* John Lee, Wellsville, Ohio, May 16.

The patentee says,—"Heretofore it has been found difficult to equalize heat in elevated ovens, and, in warm weather, to prevent the excessive heat consequent on the use of cooking stoves; and a difficulty has also arisen from their flues clogging with soot, so as to prevent their baking well, and in stoves where the elevated oven is used, no provision has been made, independently, for roasting. The improvements which I have essayed are for the purpose of remedying these various defects."

Claim.—"Having thus fully described my improvements, what I claim therein as new, and desire to secure by letters patent, is, first, surrounding the elevated oven with an air chamber between it and the flue, in the manner and for the purpose set forth.

"I also claim the scrapers placed at the junctions of the flues, so as not to impede the draught, for the purpose of scraping the revolving oven, as described.

"Lastly, I claim the combination of the oven with the revolving oven and stove, in the manner and for the purpose made known."

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34. For *Improvements in Machinery for Moulding and Pressing Bricks;* Thos. Culbertson, Cincinnati, Ohio, May 16.

The patentee says,—"My improvements are applied to a machine for moulding and pressing bricks, patented by Parsons Owen, on the 26th day of July, 1845, which consists in arranging the moulds in a reciprocating carriage placed between two rollers, so that the clay is pressed by the upper roller (which is movable, and pressed down by weighted levers) into the moulds as they pass between the two rollers, the clay being supplied to the moulds from a hopper and clay-box, on either side of the upper roller; but this machine presents several practical difficulties: 1st, The bottoms, or followers, of the moulds are made to slide up, and are provided with projections from their underside, which run up inclined planes after the bricks have been moulded and pressed, to discharge them; this tends to cant the followers, and as all machinery for making bricks is unavoidably attended with much friction from the clay which is thrown about in the course of a short time, this part of the machine is deranged, and fails in producing good results. 2nd, The clay, after being pressed into the moulds by the roller, is carried to a knife, which cuts off the surplus, but as the knife is permanent, small stones, and other hard substances, which may, and often do, project above the upper edges of the moulds, destroy the cutting edge and frequently break the machine; the frequency of these occurrences seriously affects the operations of the machine. 3rd, No means is provided for regulating the supply of clay to the moulds, so that the bricks are of unequal density, as variations in the supply will change the quantity pressed into the moulds by the roller. 4th, No mechanical means are provided for removing the bricks after they have been forced up from the moulds. These defects and deficiencies are effectually removed, and supplied by my improvements. The first, by forcing the bricks out of the moulds by means of a vertical movement. When the carriage of moulds has moved in either direction sufficiently to have carried one set of bricks beyond the knife, the projections, or stems, of the movable bottoms, or followers, of the moulds are then above a horizontal plate jointed at each end to the arms of two arbors which are made to turn by a projection on the carriage which comes in contact with an arm on one of these arbors; this lifts the plate, which, in rising, has a horizontal movement equal to that of the carriage, so that the followers are forced up vertically, avoiding the tendency to strain their stems, or to cant them in the moulds. The second is avoided by making the knife broad, and having the back attached to an arbor provided with a weighted lever, which permits the cutting edge to rise and pass over obstructions, such as stones, &c., which otherwise would destroy the cutting edge. The third is effected by means of an adjustable gauge in the hopper, or clay-box, on each side of the pressure roller, to cut off and permit only a given thickness of clay to project above the moulds. And the fourth is accomplished by means of a bar jointed at either end to parallel vibrating arms, operated horizontally, in the same manner as the plate which lifts the followers of the moulds; this bar being provided with a sand hopper and sieve, to sand the moulds in passing over them."

Claim.—"What I claim as my invention, is, first, lifting the followers, or movable bottoms, of the moulds, to discharge the bricks by means of a plate, or equivalent therefor, which, whilst it is moved up to lift the follower, has a horizontal movement with the carriage, to avoid all strain on the moulds and their followers, substantially as described.

"Second. Hanging the knives for cutting off the surplus clay on journals, to admit of the passage of stones, or other hard substances, in combination with the movable moulds, as described.

"Third. The employment of the gauge, in combination with the pressure roller and hopper, or clay-box, to determine the quantity of clay which shall pass under the roller, as described.

"Fourth. The employment of the movable bar for removing the bricks, in combination with the carriage of moulds, as described, and in combination with this, the sand hopper and sieve, attached to, and moving with, the bar, as described."

35. For an *Improvement in Stoves;* Laban Morse & Whitman J. Lewis, Athol, Massachusetts, May 16.

The object of this stove is to burn saw-dust, tan, and other substances, in a comminuted form.

The stove is the usual vertical cylinder stove, with what the patentee calls an air distributor within, which is simply a hollow vessel, extending up from the grate to the top of the fuel, with lateral holes for the discharge of air into and through the fuel.

Claim.—"What we claim as our invention, is the air-distributor, as arranged, constructed, and combined with the stove, and used substantially in the manner and for the purpose as above specified."

36. For an *Improvement in Andirons for Fireplaces;* John R. Remington, Lownds county, Alabama, May 16.

The patentee says,—"The nature of my invention consists in forming that portion of the andiron which sustains the fuel into a box, that shall receive from the corners of the fireplace the air which usually goes up the chimney and tends to decrease the draught and prevent, or retard, the ignition of the fuel, and directs it, when heated, under the centre of the fire, by which a more perfect combustion of the fuel is obtained, and all tendency to smoke is prevented."

Claim.—"Having thus fully described my improvements, what I claim therein as new, and desire to secure by letters patent, is constructing the andiron in the manner described, so as to form an air-box in the corners of the fireplace, as above set forth."

37. For an *Improvement in the Smut Machine;* Henry Staub, Martinsburg, Virginia, May 16.

Claim.—"Having thus fully described the construction and operation of my machine for cleaning wheat, I would observe that I do not claim the use of beating wings with roughened surfaces, for cleaning wheat of smut, garlic, &c.; but what I do claim as my invention, and desire to secure by letters patent, is the giving the face of the beating wings of my improved smut machine a rough and sharp cutting surface, by covering them with a series of saws overlapping each other, and arranged substantially in the manner set forth."

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38. For *Improvements in Machinery for Making Wrought Nails;* Albert W. Gray, Middletown, Vermont, May 16.

Claim.—"Having thus fully described the respective parts of my machine for making wrought nails, what I claim as new therein, and desire to secure by letters patent, is the manner set forth of drawing out the nail rods, by means of a series of rollers on the ends of arms attached to a revolving shaft, which rollers operate on the rod as it lies on a yielding die, constructed and operating substantially in the manner made known.

"I also claim the employment of the spring tongs, which are made alternately to open and close, so as to grip and liberate the nail rod, and to slide back and forth, in the manner and for the purpose described; and these I claim whether the respective parts thereof be formed and operated precisely in the manner described, or in any other in which the same ends are attained by means substantially the same.

"There are some points of novelty in the heading apparatus used by me, but in its general features it is like some other machines used for the same purpose, and its parts may admit of several different modifications. I do not think it necessary for me, therefore, to make any claim to this particular instrument; but I have described it particularly as making a component part of the general machine, so arranged and combined as to co-operate therewith in a very advantageous and convenient way."

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39. For *Improvements in the Process for Manufacturing Iron directly from the Ore, and in the Apparatus therefor;* J. F. Winslow, Troy, New York, May 16.

The patentee says,—"My improved process is applicable to the treatment of oxides of iron only; and this I effect in reverberatory furnaces, although some parts of the process may be applied in furnaces without the reverberatory feature.

"It has long been essayed to reduce the oxides of iron directly into the metallic state by heating the ores mixed with carbonaceous matter, with the view to produce deoxidation, and then to transfer the mass thus treated to the puddling process; but in all these, which have so far been unsuccessful, the upper stratum only of the mass of ore and carbon was exposed to the direct action of the heat and flame, instead of the whole mass; and to avoid this evil, it has been suggested to apply heat to the mass of ore and carbon below as well as above, by placing the fire grate directly under the furnace hearth, or floor, and then reverberating the flame and passing it over the charge. This modification, while it removes the leading objection of the process above indicated, introduces practical difficulties of such magnitude as to defeat the contemplated object.

"My improvements effectually avoid these difficulties, and consist in exposing the mass of pulverized ore, mixed with carbonaceous matter to the combined action of a gentle flame, or heat; and currents of heated air passing through the mass, which, in their passage, not only agitate the mass to aid the mechanical liberation of the gases evolved, but aid in evolving the gases from the oxide and carbon, which, in their nascent state, combine and revive the metallic particles.

"The mass is then subjected to the combined action of a more intense flame, and to highly heated currents of carburetted hydrogen gas, that pass through the mass and take up the remaining oxygen of the ore, and revive the metallic particles; and then the mass passes to the puddling process, where it is subjected to a still more intense heat, and to the action of jets of highly heated atmospheric air, to consume the carbonaceous matter, and free it from other impurities. For the application of my improved process, I have made important modifications in the well-known reverberatory furnace, which, for this purpose, is made of much greater length than those heretofore used."

Claim.—"What I claim as my invention in the process of making malleable iron directly from the ore, is the passage of heated atmospheric air through the mass of ore and carbonaceous matter in the process of deoxidizing, as herein described. I claim, also, the passage of hydrogen, or carburetted hydrogen gas, through the mass, in the process of deoxidizing iron ore, substantially as described, whether this be done after the ore has been partly deoxidized by the previous part of the process or not.

"And I also claim treating the mass in the puddling chamber with a blast of highly heated atmospheric air, to consume the carbonaceous matter, substantially as herein described.

"And, in the furnace above described, I claim, as my invention, making the plate, or bed, on which the ore is placed for deoxidizing, with numerous perforations, for the introduction and passage of highly heated atmospheric air, or other gases, through the mass, for the purpose and in the manner described.

"I also claim this perforated plate, or bed, as described, in combination with the puddling chamber, as described."

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40. For an *Improvement in the Apparatus for Feeding Furnaces for Smelting;* Squire M. Fales, Baltimore, Maryland, May 16.

Claim.—"I do not claim as my invention, feeding furnaces through a feeding tunnel simply, as this has been done; but what I do claim as my invention, and desire to secure by letters patent, is the combination of the tube and piston, for forcing in the coal, &c., in combination with the feeding tunnel and furnace, as described, whether the furnace be for smelting or for other purposes, as described."

41. For an *Improvement in Stoves;* James Wilson, New York city, New York, May 16.

Claim.—"The general course of the draught in my stove is the same with that of others previously made, and does not, therefore, form any part of my claim to novelty; but what I do claim as new, and desire to secure by letters patent, is the manner described of forming the partitions between the descending flues and the ascending flue in the rear of the oven, by means of which, I increase the radiating surface of the rear oven plate, and augment the temperature of that part."

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42. For an *Improvement in Propelling Boats;* Wm. P. McConnell, Washington, District of Columbia, May 16.

This consists of hinged paddles hung to frames that have a sliding reciprocating motion in channels under the boat, so that when moving in one direction they present their full face to the water, and feather in returning. The ends of these paddles are curved, so as to avoid too great a shock in closing. One such paddle is placed the reverse of the others, for the purpose of backing.

Claim.—"Having thus fully described the nature of my invention, and shown the operation thereof, what I claim therein as new, and desire to secure by letters patent, is the combining, in the manner described, of the propellers and the analogous backing apparatus, within cavities prepared to receive them, but which are entirely open below, the whole being constructed, combined, and operating substantially in the manner set forth.

"I also claim the giving to the leaves of said propellers a curved form, and making them elastic towards their points, in combination with the frames against which they strike, for the purpose and in the manner described."

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43. For *Improvements in Locomotive Engines;* M. W. Baldwin, Philadelphia, Pennsylvania, May 16.

Claim.—"What I claim as new, in the last described arrangement, is the connecting of the rods which are used as constituting a part of of the frame of a six or eight wheeled locomotive, as described and represented; and also the connecting rods which embrace the crank pins upon the wheel, by forming a spherical segmental shell on one end of said rods, and attaching them together, in the manner set forth, so that such rods shall not only have perfect freedom of motion, but shall also stand in a line with, or directly behind, each other, at their junction.

"I do not intend to make any claim, under either of the foregoing heads, to either of the parts of the respective devices claimed when taken individually, but I restrict the said claims to the respective combinations described; not intending, however, by this disclaimer, to limit myself to the precise form of the respective parts, but to vary these as I may think proper, whilst I adhere substantially to the principle or manner of arrangement fully made known."

44. For an *Improved Auger for Boring Earth;* Joshua Hobart, Dubuque, Iowa, May 23.

The lower plate of the auger has, in the centre, a screw similar to the body of the common wood auger, radial cutters with openings provided with valves, to admit the earth and prevent its escape when the auger is being drawn out of the hole; and for the purpose of loosening the earth, gouge-formed teeth, called ploughs, project from the under surface.

Claim.—"What I claim in the foregoing described machine, and desire to secure by letters patent, is the combination and arrangement of the several parts, to wit: the plough, spiral screw, projecting tipped knives, and valves, in their application to the mining auger."

45. For an *Improvement in Hot-air Furnaces;* Wm. G. Wing, New Bedford, Massachusetts, May 23.

Claim.—"I do not claim the combination of the inner hot-air chamber with the smoke chamber (immediately surrounding it) and the outer hot-air chamber immediately surrounding the said smoke chamber; but that which I do claim is my aforesaid improvement, or manner of causing the air to circulate through the inner air chamber, for the purpose of protecting the bottom part or plate of the said air chamber from being too rapidly burnt out, and also for the purpose of causing the said air to absorb more heat than it would if allowed to circulate in an undivided chamber, and escape at the top thereof; my said improvement consisting in the employment or arrangement of the partitions, and induction and eduction passages of the inner air chamber, in such manner (as described) as to cause the air, which is received into the inner air chamber, to impinge in a current perpendicularly or directly upon the upper surface of that portion of the bottom plate of the said air chamber, which is exposed to the direct action of the flame from the fire-pot, or furnace, beneath it; the whole being substantially as set forth."

46. For an *Improvement in Forge Bellows;* Jeremiah Darling, Adrian, Michigan, May 23.

Claim.—"Having thus fully described my improved bellows, what I claim as my invention, and desire to secure by letters patent, is the combination of a series of bellows on the inside of an enclosed case, and operated by a crank in the centre, substantially in the manner and for the purposes set forth."

47. For a *Machine for Reaming the Bands of Brass Faucets;* Wm. Read, New York, May 23.

The nature of this invention "consists in the method of applying to the drill a universal joint, in such manner as to cause the drill, or reamer, to accommodate itself to the position of the faucet, insuring a true bore at whatever angle the faucet may be with the mandrel above it."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the dividing the mandrel into two parts, and connecting them by a universal joint, and applying the motion to the reamer by means of the yoke at the bottom of the lower mandrel, embracing the arms of the wrench, fitted into the head of the reamer in such manner that the reamer may only receive a revolving motion from the mandrel, but in every other motion it may act independent of the mandrel, and being tapering, and the whole length of the hole to be reamed, it may revolve in a true circle, and insure a true and correct bore, although the line of the required bore may not be exactly in a line with the main mandrel, or shaft, which gives motion to the reamer."

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48. For an *Improvement in the Machine for Excavating Ditches;* Wm. Y. Singleton, Springfield, Illinois, May 28.

The forward end of this machine is provided with cutters, to form the bottom and sides of the ditch, and from the back of this an inclined trough extends, to deliver the earth which is drawn up on it by an endless chain of conveyers, on to an endless chain at right angles, which, in turn, delivers the earth to form the embankment. The inclined trough is suspended to the standards of the carriage frame by two hangers that turn on stud pins, to admit of adjusting the cutters and trough to the required depth, &c.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the adjustable inclined trough and excavator, and revolving endless belt of conveyers working thereon, for cutting and conveying the earth, arranged and operated in the manner before described, or other mode substantially the same, with the carriage for supporting and carrying the same."

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49. For an *Improvement in the Water Wheel:* F. P. Haviland & E. Tuttle, Waterville, Maine, May 28.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the manner in which we lay out and form the two straight sides of the buckets we use on our improved wheel, to wit: the extreme points of the buckets being placed at the distance of thirty degrees, or thereabout, from each other, their two straight sides meeting at an angle of twenty degrees, or thereabout, and their rear sides being at an angle of thirty degrees with the radius of the wheel, as laid out according to the directions, substantially as set forth."

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50. For *Improvements in the Jacquard Frame, for Weaving Figured Fabrics;* John Perrins, Philadelphia, Pennsylvania, May 28.

The patentee says,—"In the jacquard frame, as heretofore made and now used, the trap boards, through which the tail cords pass, and by which they are lifted, are each operated by separate levers, thus requiring as many levers and separate operations as there are trap boards; and in the mode of mounting to form the harness as at present practised, each division of the tail cords (all that pass through one trap board I will call a division) is in connexion with one color only, (it will be understood that when I speak of one color only, I mean also the threads connected with the mails of one pair of lifters,) and that, as a necessary consequence, when the threads of one color (or combination of colors in a pair of lifters) are to be used to interweave the picks, the cards must be shifted and a new card presented for each pick.

"The object of my improvement is to simplify the structure and operation; first, by connecting all the trap boards, by horizontal slides, with a vertically sliding frame, operated by one single lever, so that all the trap boards are lifted together, the lifting of the tail cords being governed by the sliding of the trap boards, that are provided with notched holes through which the cords pass, so that when the trap boards are shifted, (which is done by cams on a rotating shaft, turned by the sliding of the trap board frame, or any other intermitting movement,) the knots on the tail cords, which have been shifted by the needles, are caught and lifted; and, secondly, by connecting the tail cords that pass through one trap board with the mails on two different pairs of levers, so that the mails of each lifter of one color, or one set of colors, are connected with two trap boards, and so of the other colors. The advantage of this arrangement is, that one card only is required for each lash, as the interweaving of one color can be effected by one card, in consequence of the connexion of the mails of each lifter of one color, each with two separate trap boards; while, by the old plan, it is necessary to shift the needles to interweave the same color, as the shifting of the threads of one color can only be done by shifting the needles by a change of cards, in consequence of the connexion of all the mails of one color, or one set of colors, with one trap board."

Claim.—"I am aware that one division of mails, carrying one color, or set of colors, have been connected with two trap boards, by having two sets of trap boards, one above the other, requiring separate and distinct movements to operate them, thus rendering the machinery more complex and expensive; and, therefore, I wish it to be distinctly understood that I do not claim as my invention simply connecting one division of mails, carrying one color, or set of colors; but what I do claim as my invention, and desire to secure by letters patent, is connecting each division of mails with two divisions of tail cords, as herein described, whereby I am enabled to use but one card for each lash of any number of picks, as described. And I also claim as my invention, connecting, by means of horizontal slides, all the trap boards with one vertically sliding frame, as herein described, whereby all the trap boards are operated by one lever, as herein described."

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51. For an *Improvement in Registers for Hot-air Furnaces*; Ebenezer Barrows, New York, May 28.

Claim.—"Having thus fully described the manner in which I construct and arrange my apparatus for the opening and closing of the valves of registers for air-heating furnaces, what I claim therein as new, and desire to secure by letters patent, is the manner set forth of employing a hemispherical body, furnished with volute-formed openings, or threads, which receive and operate upon pins extending from the middles of the valves adapted thereto; the whole combination and arrangement, and the consequent operation of the parts, being substantially the same with that fully made known."

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52. For an *Improvement in the Ditching Machine;* J. R. Remington, Lownds county, Alabama, May 28.

The sides of the ditch are to be cut by two circular cutter wheels, and the bottom by the cutter of what is well-known as a "road-scraper," the bottom of which is inclined, to deliver the earth at the required elevation, and on this inclined bottom there are two wheels, one placed behind the other, with scrapers projecting from their peripheries, the first takes the earth from the bank, and delivers it to the second, which, in turn, delivers it at the top, to form the embankment.

Claim.—"Having thus fully described my improved ditcher, what I claim therein as new, and desire to secure by letters patent, is the combination of cutter wheels, scraper, and elevators, substantially in the manner and for the purpose above described."

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53. For an *Improvement in the Manufacture of Iron and Steel;* Charles Low, England, May 28, 1846; antedated May 25, 1844.

We are induced to insert the whole specification of this patent, in consideration of the great interest taken in the progress of improvements in the manufacture of iron, but we do not wish to be understood as expressing any opinion on the merits of the invention.

"To all whom it may concern: be it known that I, Charles Low, of Robinson's Row, Kingsland, in the county of Middlesex, in that part of Great Britain called England, have invented an improved method of making and manufacturing iron and steel, and I do hereby declare that the following is a full and exact description, that is to say, I use manganese, in the state of the black oxide of commerce, or in any other state of oxidation, plumbago, or graphite, commonly called black lead, charcoal, and nitrate of either potash, soda, or lime, that which I commonly employ is the saltpetre of commerce. These four ingredients I mix well together in the following proportions, and apply in the following manner, viz: of oxide of manganese, I take forty-two pounds; of wood charcoal, fourteen pounds; of plumbago, eight pounds; and of saltpetre, two pounds. In the blast furnace, I add to every charge of ore likely to produce four hundred and eighty pounds weight of metal, sixty-six pounds of the above mixture, either with the iron-stone, or fuel, it being immaterial which, so that the proportions are attended to and regularly applied with each charge. In the puddling furnace it can be applied with equal advantage, when the pig-iron is in a fused state, by throwing upon the surface of the metal a few pounds at a time, say two or three, and continuing doing so at intervals of a few minutes, the puddler incorporating it by stirring it with the metal, till the whole sixty-six pounds are used, or until the metal begins to thicken, or, as the workmen call it, 'comes to nature.' It is then 'balled,' and sent to the tilt-hammer, and rollers, and put through the usual process so well understood and practised in making malleable iron. This being attended to, I have never found the result fail, but I have always obtained an iron of uniform quality, admitted to be much more fibrous, and possessing a greater tenacity than any with which it has been compared, and capable of making excellent steel by the usual process of cementation, or other process, by which steel is made.

"Another part of my invention consists in the use of the aforesaid mixture for improving the quality of iron, by being applied in any of the processes of smelting, puddling, and casting, in the blast furnace, the puddling furnace, and cupola furnace, or other furnace that may be used by the iron-master, or founder, in like proportions, as above described, adding more or less of the compound, according to the quality of the metal used, of which quality the iron-master, or founder, or his workmen, will be able to judge; but I have found the quantity above named sufficient for the worst ore or metal.

"Another part of my invention consists in the application of the above mixture to the manufacture of cast steel from malleable iron which has been made by the above processes; to effect this, I add from two to three pounds of the above mentioned mixture to every thirty pounds of steel, when in the melting-pots, during its conversion into cast steel; or the object may be more immediately effected by adding the ingredients in the same relative proportions as for steel to the malleable iron, made as above, and then the application of a moderate heat (such as a little practice will enable the workmen to ascertain) will fuse the iron in contact with the mixture; and immediately convert it into cast steel. I recommend, as the best way of preparing the ingredients for use, that they should be ground in a mill suited to such purpose; for the puddling furnace, they should be ground to a moderately fine powder, and I should prefer their being applied from the top of the furnace, through a hopper, or tube, or such like means as would spread them more evenly than if applied by hand from the furnace door. But for the blast furnace, and cupola furnace, they would be better applied in a coarser state. I have made my calculation upon 480 pounds weight of metal, having found that to be the charge of pig-iron usually applied at one time to the puddling furnace, but the workmen will have no difficulty in judging, by the working of the metal, whether a less or greater quantity of the ingredients should be used.

"Lastly, I do not claim the exact proportions as above described, as they must somewhat vary for different qualities of iron-ore and iron, or of the ingredients themselves, nor do I claim the use of any of the aforesaid ingredients separately, as they may have been made use of before; but I claim the use of them collectively, and in the proportions herein substantially set forth, in the manufacture of iron or steel, either in the blast furnace, puddling furnace, cupola, or other furnace, or in the melting-pot."

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54. For an *Improvement in the Steam Whistle for Locomotives;* M. W. Baldwin, Philadelphia, Pennsylvania, May 28.

Claim.—"Having thus fully described the nature of my improvement in the manner of operating the steam whistle of a locomotive engine, what I claim therein as new, and desire to secure by letters patent, is the manner in which I have combined the main valve and the whistle, and arranged the respective parts for operating said whistle, by making a perforation through the safety-valve and its stem, there being a valve closing the lower end of said opening; which valve is to be operated upon, and the respective parts arranged, substantially as described."

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55. For an *Improvement in the Balance Valves of Steam Engines;* W. H. Baker & H. R. Worthington, Brooklyn, New York, May 28.

The patentees say,—"In constructing our balanced slide valve, we so arrange the respective parts thereof as to cause the steam to operate equally on opposite sides of the sliding part thereof, allowing the steam to enter into, and escape from, the cylinder equally on each side of said valve. In effecting this, we sometimes cause the valve to slide between two stationary check-pieces in each of which are contained three openings, operating in the ordinary way for the induction and eduction of steam.

"Instead of the two stationary check-pieces above named, we sometimes employ one stationary valve seat, which is embraced on each of its sides by the slide valve, the stationary valve seat being furnished with three steam openings on each of its sides, so arranged as to produce the same result with that first named, and in a manner substantially the same; the two modes being mere modifications of one principle."

Claim.—"Having thus fully described the nature of our improvements in the manner of constructing a balanced slide valve for steam engines, what we claim as new therein, and desire to secure by letters patent, is the causing the steam to operate equally on, and through, its two opposite sides, under an arrangement of the respective parts, such as herein set forth; that is to say, by the employment of check-pieces, between which the valve may slide, or of an elevated block, on each side of which the sliding valve is to operate, together with any such modification thereof as shall be substantially the same in its structure and operation, producing the same effect by like means."

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56. For an *Improvement in Stoves;* John B. Clute, Schenectady, New York, May 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the two side flues with the vertical flues of the elevated oven."

57. For an *Improvement in the Plough Clevis;* Charles L. Meech, Preston, Connecticut, May 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making one arm of the clevis to extend back to within reach of the person who holds the plough, to which arm a regulator is attached for governing and securing the same, and thus giving any desired pitch to the plough without stopping, or checking, the team; using, for the construction of the same, the most proper, cheap, and durable material which will produce the intended effect."

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58. For a *Rotary Steam Engine;* Richard Field Stevens, St. Louis, Missouri, May 30.

The patentee says,—"The nature of my invention consists in providing an aperture, or opening, extending throughout the circumference of a wheel, and communicating with a hollow, or chamber, within, with a flexible hoop, ring, or band, which may be so applied to the said opening as to confine steam, or other moving agent, within the hollow of the wheel, in order that its power may be communicated directly to the periphery of the wheel."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of a flexible hoop, ring, or band, to an opening communicating with a hollow, or chamber, in the rim of a wheel, in such a manner as to close the opening in a part of its circumference and leaving it open in the remainder, thereby allowing a communication with the chamber upon one side of the wheel, while the opposite side is closed, and the moving agent confined in such a manner that its power is expended directly and constantly upon the periphery of the wheel. The said hoop or band may be made of any flexible substance; may be made of any convenient form; may be made continuous, or jointed, or a part only of the hoop, or ring, may be used and applied to the opening, in the same manner as a portion of the continuous hoop, or ring, above described.

"The hoop, or ring, may be applied to either side of the chamber, in such manner as to produce the desired effect, operating as a circular valve."

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59. For *Improvements in Furnaces for Steam Boilers;* Henry F. Baker, Boston, Massachusetts, May 30.

Claim.—"What I claim, and desire to secure by letters patent, is one or more reverberating chambers, (made and arranged as above set forth,) in combination with the fireplace and boiler; the same being made to revolve and retain the volatile products underneath the boiler long enough to be consumed thereunder, as above explained. And I also claim the manner of arranging the air distributing boxes, with respect to the bottom of the boiler, in combination with the curved deflecting bottoms of their respective chambers, in order that the flame produced by the combustion of the volatile gases, or other matters passing over the perforated plates of said air-boxes, may be blown in jets against the bottom of the boiler, as set forth; the said mode of arranging the said air-boxes, consisting in giving each of them an inclined position, substantially as represented in the drawings, and as above specified."

60. For an *Improvement in the Machine for Excavating and Removing Earth;* patented by Wm. J. Otis, on the 24th day of February, 1839; D. Carmichael & J. C. Osgood, the former of Brooklyn and the latter of Chittenango, New York, May 30.

For a description of the original machine, the reader is referred to page 110 of the 25th volume of this journal, second series.

Claim.—"Having thus fully described the manner in which we construct, and operate our improved excavating machine, what we claim therein as new, and desire to secure by letters patent, is the manner herein described, in which we have connected and combined the scraper-staff, or arm, with the machine, so that it may be raised or lowered by means of the racks and pinions, (by the aid of the triangular piece,) arranged and operating as set forth, thereby dispensing entirely with the hollow mast, and with the toothed gearing and chains combined with said mast, as used for that purpose, in the original machine of Otis."

61. For *Improvements in the Machine for Cutting the Threads of Wood Screws;* Thos. W. Harvey, New York, May 30.

The patentee says,—"The nature of my invention consists, first, in arranging the screw blanks, in a continuous row, when thrown promiscuously into a hopper, and delivering them, one by one, without the necessity of an attendant, which is effected by means of two inclined rollers, placed far enough apart to permit the shanks of the screws to hang vertically between them, so that, by their rotation and inclination, they cause the blanks to arrange themselves side by side, with the heads resting on, and the shanks hanging between, them, and thus gradually to force them towards the delivery end.

"My second improvement consists in taking the blanks from the ends of the rollers, and delivering them into a vertical conveying tube, by means of a slide which has an aperture in it that admits the blank, and by its motion, and the oblique side of the aperture, forces it, horizontally, and in a vertical position, to the aperture of the delivery tube, down which it descends, at the same time checking the further descent of the blanks between the rollers until its return, the aperture being so formed as to permit the descent of the blanks into it from the rollers before the repetition of the delivery operation.

"My third improvement consists of a pair of spring conveying fingers, which are presented to the lower end of the vertical tubes down which the blanks descend, and slightly opened by coming in contact with a projection from the lower end thereof to receive the end of the blank as it descends, and which is griped by the fingers as they are moved away; the conveying fingers projecting from a shaft, so operated, by a slide, and a series of cams and levers, that it rotates through a part of a circle to bring the blank in a horizontal position, and then horizontally, to present the head of the blank to the gripers, preparatory to cutting the threads.

"My fourth improvement relates to the employment of gripers jointed to a chuck, or head, at the end of a hollow mandrel, and connected to one end of a sliding rod within the mandrel, the other end being connected with a slide governed by a cam, the sliding of which causes the gripers to take hold of the blank just within the head, to rotate it whilst under the operation of the chasing tool, when this is used in combination with a turn screw, that slides within, or on, the sliding rod, and forced towards the head of the screws by a spring, so that if the blank should turn in the gripers, in consequence of the bite in the chasing or threading tool, the turn-screw will be forced into the nick in the head, and there hold it.

"My fifth improvement relates to the arrangement of the thread cutter or chaser, and the sliding rest, the latter of which is secured to a sliding chasing frame or carriage, for the purpose of preventing the shanks of the screw from yielding while under the action of the chaser; which latter is also properly secured in an adjustable tool holder or head, jointed by its lower end to the chasing sliding frame, the upper end sliding on a rod secured to a sway bar, one end of which is jointed to an adjusting slide, and the other governed by a cam which gives the requisite taper and point to the screw. The chasing frame is governed in its motion by a chasing cam groove on a cylinder, the groove being so formed as to move the chasing slide to carry the cutter gradually from the commencement of the thread towards the point, with a motion so regulated relatively to the rotation of the mandrel as to give the pitch of the thread, and then moved back again for another cut, one part of the groove crossing the other for this purpose; and that part of the groove which moves the chasing slide for chasing the thread is in the form of a helix, and at the end thereof it crosses the helix with a sudden curve to run back the chaser, and at the end of the helix the groove runs into another groove, the junction of these two being provided with a sliding switch, connected with a sliding rod within the chasing cam shaft, and so governed by another cam, called the index cam, that when the thread is chased the switch is shifted, which opens this latter groove to draw the chasing frame and chaser far enough out of the way to admit of the operation of the conveying fingers to supply a new blank.

"My sixth improvement relates to the method of adjusting the motions of the chaser to the varying lengths of blanks, and to the different form of points, so as to insure the formation of good points on the screws by making the cam which governs the motions of the sway bar adjustable on its shaft.

"And my last improvement relates to the mode of changing the cams that operate the conveying fingers—the griping cam and the chasing cam—by means of an index cam, which operates sliding twitches, through the intervention of sliding rods, within the hollow mandrel and the cam shafts.

"By means of these improvements I constitute an automatic machine, which performs all the operations of arranging the blanks in regular order, supplying them one by one, conveying them to the gripers, chasing the thread with any desired taper and point, and discharging the chased screw, with no other human labor than is necessary to keep the mechanism in order, and to throw a large quantity of blanks into the hopper at given intervals."

Claim.—"What I claim as my invention in the above named machine, and desire to secure by letters patent, is—

"*First.* The method of arranging screw-blanks and all other similar articles, and regularly delivering them by means of two inclined rollers, substantially as described, whereby the rollers, by their inclination and rotation, cause the screw-blanks thrown into the hopper promiscuously at the upper end to arrange themselves with the shanks hanging in the space between the rollers and the heads resting on their peripheries, and thus gradually to descend towards the delivering end : and this I claim whether both or only one of the rollers be made to rotate, or whether the rollers constitute the bottom only or the entire hopper.

"*Second.* I claim the delivery slide in combination with the tube or any analogous device, into which the blank or other similar article is discharged, substantially as described, whereby the blanks received from a hopper or other feeder are delivered in a vertical position into a conveyer, and the further delivery from the hopper is checked until a repetition of the operation is required as described.

"*Third.* I claim so operating the fingers as to receive the blanks, &c., in a vertical and change them to a horizontal position, and move them forward to introduce them in the gripers, substantially as herein described.

"*Fourth.* I claim the gripers in combination with the sliding spring turn screw, substantially as herein described, by means of which combination the blank is prevented from turning by the turn screw in the nick, the gripers simply holding it steady and in such a central position without defacing the head and shank, and by which also the turn screw is made to enter the nick irrespective of its direction when the blank is introduced as described.

"*Fifth.* I claim governing the motions of the chaser towards and from the axis of the blank, by combining the chaser-head with a carriage and sway-bar moved by a cam, substantially as described. And I also claim connecting one end of the sway-bar with an adjusting slide, when this is combined with the chaser or chaser-head, as described, whereby the amount of taper to be given to the screw can be regulated at pleasure.

"*Sixth.* I claim changing the directions of the various cam grooves by means of sliding switches operated by sliding rods with the hollow cam-shafts, and shifted by an index cam, by which the various changes of the motions of the machine are effected, substantially as described.

"And, finally, I claim making the cam which operates the sway-bar adjustable on its shaft, substantially as described, for the purpose of adjusting the motions of the chaser to the length of the blank, to insure the proper formation of the point of the screw, as described."

62. For an *Improvement in the Plough;* David Anthony, Sen., Union Springs, New York, May 30.

We are under the necessity of omitting the claim in this case, as it refers to, and is wholly dependent on the drawings. It is limited to the combination of parts that constitute a metallic socket for fastening the beam to the handle.

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63. For an *Improvement in the Cooking Range;* Julius Fink, Philadelphia, Pennsylvania, May 30.

This range is made with the front in the form of a segment of a polygon, one face for the fire chamber and one for each of the ovens that are placed one on each side of the fire chamber, which is by this means wedged-formed, wider in front than at the back; and back of the fire chamber, and between the two ovens, there is an air heating chamber, which is thus heated by the fire back, and the two ovens.

Claim.—"Having thus fully described the construction of my improved range, and shown the manner in which the respective parts thereof are made to operate, what I claim therein as new, and desire to secure by letters patent, is the particular manner in which I have arranged and combined the two ovens, the fire-chamber and the water-back, or air-heating space between said ovens and the respec tive flues, as herein set forth.

"I do not claim either of these features as new in itself; but I do claim them as new and pre-eminently useful in their combined capacity."

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64. For a *Machine for Cutting Corn and Brush;* Edwin Owen, Byron, Indiana, May 30.

To one side of the forward part of a carriage are attached two knives with their edges coming together at the heel, which is placed higher than their points to make an oblique cut on the stocks, the edges having a corresponding inclination.

Claim.—"Having thus fully described my improvements and their operation, I wish it to be understood that I do not claim the diverging knives, as they have been used; nor do I claim attaching oblique knives to a carriage, for the same reason; but what I do claim as my invention, and desire to secure by letters patent, is the diverging knives fastened to a carriage, in the manner described, with their points depressed and their edges elevated, substantially in the manner and for the purpose herein set forth."

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65. For an *Improvement in the Plough;* James Johnson, Wooster, Ohio, May 30.

The land side and mould-board are each made to lap into each other near the lower edge, and higher up they have each of them a projecting ear that laps on to each other, the brace rod that extends up to the beam being made to pass through these ears.

Claim.—"Having thus fully described my improvements, what I claim therein as new, and desire to secure by letters patent, is the mode herein described of connecting the mould-board and land-side of a plough, and bracing them by means of the projections, the bracing rod, and the connexion below, in the manner and for the purpose specified."

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66. For an *Improvement in the Cultivator for Cotton;* John Merril Cullen, Benton, Mississippi, May 30.

To the forward part of the plough there is a set of rake teeth, which project vertically downwards from the beam and on the land-side, and back of these a series of scrapers, but the teeth and scrapers do not extend down so low as the lower edge of the land-side.

Claim.—"Having thus described my improvements, what I claim therein as new, and desire to secure by letters patent, is the combination of the scraper, and rake or harrow, with the cultivator, in the manner and for the purpose set forth."

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67. For *Improvements in Steam Boilers ;* Elkanah Ingalls, Providence, Rhode Island, May 30.

The claim refers to, and depends on, the drawings, and hence we are under the necessity of omitting it.

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68. For *an Improvement in the Rotary Steam Engine;* James Black, Philadelphia, Pennsylvania, May 30.

Claim.—"Having thus fully described my rotary engine, what I claim therein as new, and desire to secure by letters patent, is the combination of the rotary pistons with the lateral steam passages or chambers on each side of the same, in such a manner, that the steam shall pass from one chamber to another through the passages between the pistons in regular succession from the steam-pipe to the escape-pipe, at the same time acting upon the pistons, substantially in the manner herein set forth."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent for an Improvement in the Hydraulic Ram, called "Strode's Pneumatic Hydraulic Engine," granted to Joseph C. Strode, *of East Bradford township, Chester county, State of Pennsylvania, March 27th,* 1847.

The nature of my invention and improvement consists in making use of a column of condensed air between the propelling fluid and the fluid that is to be raised; said air being condensed in a pyramidal-shaped chamber, by means of the momentum of a descending column of water; said chamber having a communication, by a small opening at its top, with another chamber, into which the spring water, or fluid to be raised, is introduced, called the spring water chamber, and upon which the condensed air in the first named chamber is made to act, causing said fluid to rise through a tube placed in the spring water chamber, (open at its lower end, and closed alternately at its upper end, by means of a valve,) into a large air vessel, or receiver, of the usual form and construction, being conducted thence to its place of destination by pipes, or hose, in the usual manner.

Fig. 1.

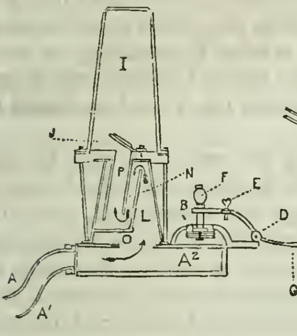


Fig. 2.

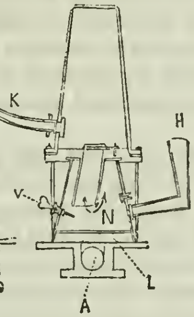


Fig. 3.

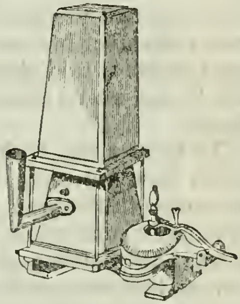


Fig. 1 is a longitudinal section.
Fig. 2 is a transverse section.
Fig. 3 is a perspective view.

Similar letters in the several figures refer to corresponding parts.

A is the main pipe for conducting the propelling water from the head, or reservoir, to the pyramidal air chamber. This pipe descends below the level of that portion of it which connects with the air chamber just before it reaches the said chamber, and then ascends, in a curved line to it, forming a curved bend in the pipe, as at A', for the purpose of preventing the air received at the valve B, during the time in which the vacuum is produced in the air and water chamber, as hereafter described, from filling the pipe A, as the air will not descend at said bend in the tube, so that the surplus of said air, after having filled the condensing chamber L, may be carried off, by the current of water, through the valve B.

The pipe A is enlarged below the air chamber L, as at A², and has an opening O into the air chamber L, through which the water passes when the valve B is closed.

B is a valve attached to a curved, vibrating lever C, turning on gudgeons D, in boxes, as its fulcrum, having a set screw E, for regulating the descent of the valve, and a counter-balance F, for adjusting the valve. When this valve B is down, as shown in fig. 3, the water from the head flows through the opening, which it closes; when it is up, as shown in fig. 1, the water rises into the pyramidal chamber L, through the opening O, and condenses the air therein,

H is a pipe for conveying the spring water to the spring water chamber. I is the air chamber into which the water is forced. J is the valve for holding it. K is a pipe, or hose, for conveying the water to its place of destination. The above named parts, lettered from A to K, inclusive, are made and operated in the usual manner. The improvements are as follows:

L is a pyramidal chamber into which air is admitted through the valve B, when it descends by the pressure of the external air, to supply the partial vacuum created in the pipe A, and chambers L and N.

This pyramidal chamber has a communication, by a small opening M at the top, with another chamber N, called the spring, or pure water, chamber; through which opening M, the air, so condensed, is forced, and presses on the spring, or other water, introduced into the same through the pipe H, by which pressure, the water in said spring water chamber is forced upward through a tube P, reaching to near the bottom of said chamber N, through the valve J, into the air chamber I; said valve being represented as open in fig. 1, and as closed in fig. 2.

To raise water with this machine, open the valve B, and let the water flow out; then, by closing the valve B, the water, which is now in motion in the pipe A, will pass through the opening O, into the pyramidal condensing chamber L, and condense the air the same as before; the condensed air will force the spring water up the tube P, (which had entered through the pipe H during the continuance of the partial vacuum above spoken of,) into the chamber I, and condense the air therein, until its density is equal to that in the condensing chambers L, and N, below; at this time the spring water will cease to flow into the air chamber I, the valve J closes, and the air in the chambers I, L, and N commences expanding, that in the lower chambers, L and N, giving motion to the propelling fluid and driving it backward, producing a partial vacuum in the machine, and the air in the upper chamber I, forcing the spring water to its place of destination.

The said partial vacuum in the machine, caused by the reaction of the machine, as aforesaid, and the pressure of the external atmosphere on the valve B, will cause it to open again. The water from the head then flows through this valve with an accelerating movement, until it has acquired that degree of velocity as to cause the valve to close. The water having no longer any vent through the valve B, passes through the opening O into the pyramidal air chamber L, and repeats the operation above mentioned successively.

In this manner the operation will continue as long as the machine remains in order and there is a head of water to propel it. The valve V is for the purpose of supplying the chamber I with air, by admitting said air into the tube P. The said air is admitted during the time that the partial vacuum above mentioned takes place. The air thus introduced into the tube P ascends to the top of the same, and is forced into the chamber I at the next stroke of the machine; said valve V is represented open in fig. 2, and may be closed, or regulated, by screwing the thumb-screw V.

The principal advantages this machine possesses over other machines are, 1st. In case of forcing up pure water by the propelling power of a running stream of water less pure, there is no possibility of the impure water mixing with the pure, there being at that time a column of condensed air between the two waters.

2nd. The water being forced into the upper chamber I, by the condensation of air in the lower chamber, the valve J opens more slowly than when water alone is made the propelling medium, and also shuts more slowly, thereby preventing the water from escaping back through the valve J after it is forced up—the valve J being nearly closed when the water ceases to flow upward into the chamber L. This advantage, upon trial, is found to be of considerable importance, enabling the machine, thus operated, to force, with a given quantity of water, several barrels more of water per day than it would otherwise do.

3rd. There being no valve between the condensed air in the lower chamber and the driving water, or at the opening O, said air is permitted to act a longer time in forcing back said driving water, and thereby making a more complete vacuum than in other machines, and rendering useless the spring for opening the outlet valve B, as used in several machines.

It is not necessary that the spring water chamber N, and the air chamber L, should be enclosed by the same envelope, but they may form separate chambers, and they may be arranged in any convenient way or manner most acceptable to the constructor, provided that the capacity of the air chamber does not exceed a due ratio between the propelling power and the water to be raised.

I wish it to be understood that in the construction of these machines, I do not wish to confine myself to the form of a hollow frustrum of a pyramid, cone, or other form, for the several chambers, &c.; but I desire the privilege to vary these as I may think proper, in form, proportion, and material; provided, in all cases, that the surplus air be carried off through the valve B. I, however, prefer the forms above described when pure water is to be raised with impure water.

What I claim as my invention, and desire to secure by letters patent, is

1st. Making use of a column of condensed air between the propelling fluid and the fluid to be raised, in the manner above described, or other mode substantially the same, by which analogous results are effected.

2nd. I claim the particular combination of the pyramidal air chamber L, the internal spring water chamber N, and the water tube P, with the curved conducting pipe A′, and valve B, and the air chamber I, and hinged valve J, constructed and arranged in the manner and for the purpose substantially as set forth.

Description of a Vibrating Box for Locomotive Axles, patented by NORRIS & TULL, *of Philadelphia, June,* 1846.

The arrangement of this box allows it to revolve in a vertical plane, at the same time that it floats up and down, the journals of the drivers having, at all times, their full bearing upon the box; let the axle assume any position from a horizontal line caused by inequalities of the road, or the consequent raising of the outer rail, in passing curves, which must necessarily reduce friction in a great degree, and insure the more perfect working of the engine, without producing any undue strain in its several parts, and has only to overcome the friction which is due to the surfaces upon which it works. This evil has always been overlooked in the construction of locomotives, and which must occur when a box floats vertically in a pedestal.

Fig. 1, plate V. Elevation of pedestal with vibrating box.
Fig. 2, Cross-section of the same.
Fig. 3, Ground plan.
Fig. 4, Vibrating box.
Fig. 5, Bearing of vibrating box.

A, A, pedestal forming part of the wrought iron frame. B, vibrating box resting with the two pivots *b*, *b'*, which are firmly attached to it in openings of the two sliding pieces, *c*, *c'*. Fig. 5 shows an end view of one of the latter, with its flanches, *m*, *m'*, and the hole, *a*, which is to receive the pivot, *b*. These sliding-pieces are connected, by means of screws, *x*, *x'*, with the cross-piece, *d*, the lower surface of which is cylindrical, and forms a bearing for the upper convex surface, *n*, *n'*, of the box, B. *f*, wedge, kept by the set-screw, *f'*, in a position which allows the box to slide in the pedestal, without being too loose or too firm. *g*, oil-box. In fig. 4, this oil-box is omitted.

The same parts are marked by the same letters in the different views.

Decision in the Circuit Court of the United States for the Eastern District of Pennsylvania, at the October Sessions, 1846, *in the case of Knight* vs. *Gavit, for the infringement of a Patent Right for Driers for finishing Paper.*

Between forty and fifty witnesses were examined. After the evidence was closed, the plaintiff contended that the specification shewed that his patent was for *a machine to finish paper by the repeated contact of heated metallic cylinders, acting, with graduated temperature and pressure, on the naked sheet, while damp, in successive stages of the drying process: with an intermediate adaptation of former modes of alternately shifting the side next to the drying surface of the cylinders;*—and that on the question of invention, or of infringement, the explanatory designation of a method of gradu-

Fig. 1.

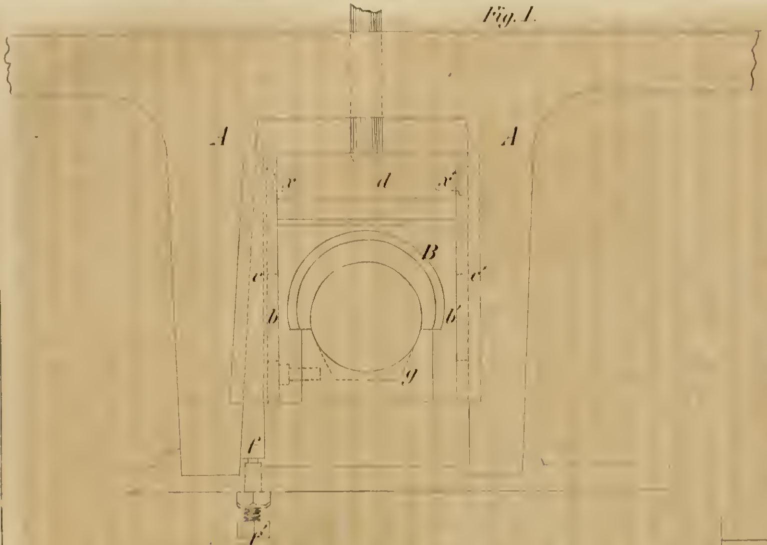


Fig. 2.

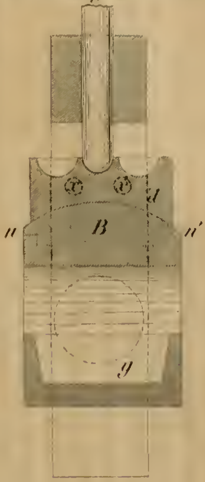
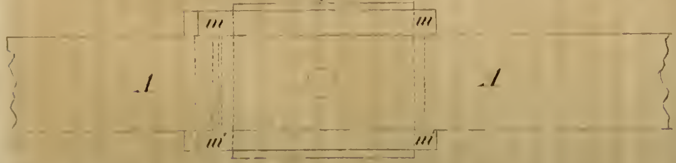


Fig. 3.



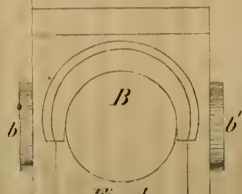


Fig. 4.

Fig. 5.

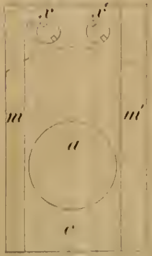


Fig. 6.

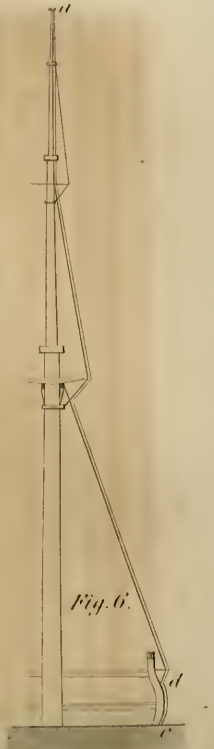


Fig. 7.

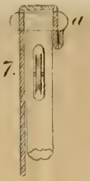
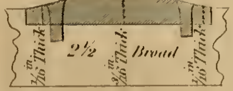


Fig. 8.



ating or preventing the closeness of contact of the two first cylinders did not exclude the optional use of other modes of postponing or graduating original contact or pressure, as might be deemed best for the protection of the moist sheet against injury from premature or excessive pressure. He therefore requested the court *first*, to instruct the jury, that if the terms of art contained in the specification were ordinarily used and applied as testified, and if the jury believed that *the varying texture of the damp sheet, during the drying process*, as described by the witnesses, *rendered such repetition of contact of the driers a process adapted to the successive conditions of the sheet and useful in converting it into finished paper*, in the manner testified—the plaintiff's interpretation of the specification was correct in point of law, and his patent valid, if original.

Upon the question of originality, he insisted that, except in regard to the machines designated respectively as Carter's, Howe's, Fisher's, and Ames's, there was no testimony opposed to his title as an inventor; and asked the court's direction; *secondly*, that if the machines designated as Carter's, Howe's, and Fisher's, respectively, operated as had been testified, without such successive graduation of either heat or pressure, neither of these machines was identical with the subject of the plaintiff's patent; and *thirdly*, that if the machine designated as Ames's was constructed as had been testified, the impossibility of any similar graduation of temperature at the respective stages of dampness of the paper at which the sheet underwent pressure, and the incapacity of the machine to admit of a change of the side next to the drier during the continuance of the process, rendered this a different machine from that which was the subject of the plaintiff's patent. It was also contended in argument that if, through the failure, or defective execution, of Mr. Ames's purpose of a peculiar adaptation of a press roll, he had been obliged to resort to a remedy, through the use of which he had, by accident, and not design, made his machine perform, partially and inappropriately, certain functions to which the plaintiff's machine, as patented, was appropriately designed, and effectually adapted; still, as its casual and partial performance of these functions had not caused any public knowledge of the true principle and objects of the plaintiff's machine, and had not even conveyed the true idea of its principle to the mind of Mr. Ames himself, such accidental use of a mode of operation similar in part to that of the plaintiff's machine, ought not to deprive him of the benefit of his patent. But this point, though insisted on, was not argued at large, as the plaintiff relied confidently on the two radical points of distinction between his machine and that of Ames, on which the instruction to the jury was requested as above.

The defendant's counsel submitted the following points for the court:—

The court is requested by defendant to charge:

1. That no action can be maintained for the violation of a patent by any persons who are not the owners of the patent, or the exclusive owners of a license for the places where the violation occurred.

2. That the owners of two-thirds of a patent cannot maintain such an action.

3. That if the plaintiff has sold one-third of this patent right, formerly owned by William Knight, he cannot maintain this action.

4. That the Narr. states the plaintiff to be the sole owner of this patent, and if he is not so, this action cannot be supported.

5. That the account of the plaintiff, as assignee of his father, William Knight, sworn to by the plaintiff, is evidence that he has sold the one-third formerly belonging to said William Knight.

6. That the plaintiff's patent is for a combination only; and as all parts of the machine, separately, were known and used before, the violation must consist in the use of the combination described, and not for making the separate parts of the machine.

7. That making a machine in all respects like the plaintiff's alleged patent, in which the drying cylinders do not touch, is no violation of plaintiff's patent.

8. That making a machine with screws under the journals of the drying cylinders, so as to separate them, is no violation of the plaintiff's patent.

9. That if such a machine be made with screws under the journals, by which the drying cylinders may be kept apart, the machinist is not responsible for a violation of the patent right, although the purchaser should lower those screws, so as to allow the cylinders to come in contact.

10. That the plaintiff's patent is for drying and pressing simultaneously:

Not for changing the sides of the paper:

Nor for applying pressure at any particular stage of the manufacture:

Nor for applying different degrees of heat.

11. That if drying and pressing paper at the same time was known and used before the patent of William Knight, then his patent is invalid.

12. That a mere repetition or reduplication of a machine known and used cannot be the subject of a patent—merely because the same effect is increased.

13. That if Knight's machine is nothing but the use of two or three of Howe's machines, his patent is invalid.

14. Any use, however limited, of a machine similar in principle to the patented machine will defeat the patent.

15. The specification which describes only known and previously used parts of a machine, will not support a patent for a combination, unless the combination intended to be patented is clearly stated.

16. In Knight's patent, the only combination stated is for drying and pressing simultaneously, and therefore that is all the patent covers.

17. If a machine such as Mr. Knight's, or a combination such as he asserts he has patented, is described in the specification of a previous American patent, Mr. Knight's patent is invalid.

18. Ceasing to use a machine, or preferring the use of another ma-

chine, will not authorize another person to take out a patent therefor, although he should be a subsequent inventor thereof.

19. If the patentee claims all the machine described in his patent—as his combination—he claims too much, and upon that ground *this action* cannot be supported.

20. Damages are only for the use of machine proved—so long as it has been proved to be used.

Charge of the Court.

The court (Judge Kane) charged the jury as follows:

This is an action of trespass on the case brought by Abijah L. Knight to recover damages from Nelson Gavit, for an alleged breach of patent right.

The plaintiff has presented letters patent under the seal of the Patent Office of the United States, duly attested, bearing date 25th Sept., 1839. by which there was granted to William and Abijah L. Knight, and Edward F. Condit, their heirs, administrators, and assigns, the exclusive property in a new and useful improvement in the machine for making paper, of which a description is particularly given in an accompanying schedule.

The plaintiff claims to be at this time, and to have been at the time when this suit was instituted, the sole owner in law of this patent right; the former interest of Mr. Condit having been regularly transferred to him on the 22nd of May, 1841, and the former interest of William Knight in like manner transferred to him on the 15th December, 1842.

The latter transfer, however, was by a conveyance in trust, and the defendants have objected that, on that account, as well as because it was not recorded within the time directed by act of Congress, the conveyance did not pass such a title as would authorize the plaintiff to sue in his own name as assignee of that interest. This question, however, is one to be settled by the court, not by the jury. For the purposes of your deliberations and verdict, you will assume that the conveyance by William Knight to the plaintiff did pass to him all the legal rights of the assignor, and that, so far as this question is involved, the plaintiff must be regarded by you as if he had been named alone in the patent.

It has been contended, however, at a late moment in the cause, that the plaintiff ceased to be the owner of the interest which he derived from William Knight, at some time prior to the 28th of April, 1843, when he settled his accounts as assignee, and charged himself with the proceeds of sale of the assigned estate. You have seen the entry in the accounts, and have heard the evidence of Mr. Fallon as to the circumstances and purpose of making it. It only remains for the court to instruct you, as it does, that if, upon the evidence, you believe that no sale was in fact made to a third person, but that the plaintiff took the interest of William Knight at its appraised value, the transaction has not been such as to impair his right to maintain this action: That is to say, if you shall be of opinion that the plaintiff did, in fact, sell to some third person, at the time referred to, the interest which he had acquired under his father's assignment, so as to pass away his legal title in that one-third of the patent, then the plaintiff has failed to establish the title which he has set forth in his declaration,* and your verdict will be for the defendant. If, on the other hand, you are not satisfied that such a sale to a third person has been made out by the evidence, then you will proceed to the further consideration of the case, leaving to the creditors of William Knight to assert hereafter, as they may do, any right they may have to a participation in the benefits of the patent right.

The question of title under the letters patent being thus disposed of, the next topic of consideration is the patent itself, its import, the adequate clearness in which it is expressed, and the utility of the improvement it professes to recognize.

The import of this patent may be determined, without difficulty, from the instrument itself, when construed according to the known rules of law. It therefore becomes the office of the court to declare what that import is; and it will be the duty of the jury to accept the interpretation, as given by the court.

In interpreting a written instrument, all its parts are to be taken together; and, in the present case, the drawing, which forms part of the specification, is to be taken with the rest.

It is obvious, that the specification and drawing before us relate to a machine of two parts, or divisions: the first of which regards the construction of wet paper from the pulp, and the second, the completion of the process of manufacture, by drying, consolidating, and finishing the material derived from the first. It is only the latter of these parts which gives rise to the present controversy, and to this alone, therefore, our inquiries must be confined.

The parts of the specification which describe this portion of the machine are found on the four last pages of the printed copy.† After describing that which may be styled the wet machine, and the progress of the pulp paper to the drying cylinders, it goes on as follows:

[With the drawing before the jury, the learned Judge here read slowly the parts of the specification referred to.]

Taking all this together, it asserts the invention, by the patentees, of a combined machine, the several parts of which are not claimed as new. The plaintiff has requested us to charge you that this combined machine "is a machine to finish paper, by the repeated contact of heated metallic cylinders, acting, with graduated temperature and pressure, on the naked sheet, while damp, in successive stages of the drying process, with an intermediate adaptation of former modes of alternately shifting the side next to the drying surface of the cylinders."

This definition the court is prepared to adopt. It is, perhaps, however, too concise to be apprehended at once clearly. The object of the machine, as we have said, is the completion of the process of manufacture by drying, consolidating, and *finishing*. It does this by employing a series of heated metallic cylinders, of which the heat is susceptible of graduation, and which are so arranged as that some of them shall be pressed upon by the others, with regulated degrees of pressure. The naked paper, while yet damp, is made to pass alternately around and between these cylinders, and is thus progressively dried and consolidated by the heat and the pressure which it derives from them through the successive stages of the process; the two sides of the paper, as it passes, being presented alternately to the heated surface of the cylinders, as in other well known machines for drying paper.

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* *Note by the Reporter.*—It had been suggested in argument, that the plaintiff, as admitted proprietor of two-thirds of the patent right, might, independently of the objection, have sued in his own name for his damages sustained as such partial proprietor, if his title had been thus set forth in the declaration. (See 11 Ad. and El. 209.)

† A pamphlet copy used at the trial.

Such, in the opinion of the court, is the import of the specification for the purposes of this cause; and it submits to you that the principle of the combined machine is, therefore, the repeated action of heat and pressure, applied alternately and directly upon the material, in degrees adapted to its progressive character.

The number of the cylinders, except so far as it is implied in the successive character of their action, their exact relative position, provided it be not incompatible with the purposes for which they are employed, their precise dimensions, the fact that some of them may, at the option of the workman, be made, on occasion, to revolve without absolute contact, and the manner in which this may be effected, the arrangements for graduating the heat and the pressure; these, and numerous details, which, in the form of illustrations, suggestions of preference, or otherwise, find a place, not improperly, in the specification, are not looked upon by the court as essential parts of the machine: these regard matters independent of its principle and substantive character.

In thus defining the extent of the patented improvement, it will be observed that the court does not limit its view to the formal words of claim with which the specification closes. On the contrary, finding that those words "claim," in the name of the patentees, "the arrangement of the drying cylinders, for the purpose of drying and pressing the paper, *as herein described*," the court looks to the description thus expressly referred to by the patentees, and deduces from it, and from the drawing which makes part of it, the entire improvement which it was their object to secure to themselves by patent.

The construction of the letters patent thus given by the court, will be accepted by the jury as correct. Its errors, if they exist, can all be repaired, and their consequences be made innoxious by a revisory tribunal.

The next question is one for the jury upon the evidence before them. Is the specification, with its accompanying drawing, such a description of the patentee's improvement and of his mode of using it, as to enable any person skilled in the arts of machine building and paper making, to make, construct, and use the same? On this question, the court is not aware that it can aid the deliberations of the jury. So far as the evidence is recollected, the numerous witnesses, on both sides, who have spoken of the patent, have none of them adverted to any obscurity in the terms of art which it employs, or to any substantial difference between the machine as described and the machine as made. The question, however, is with you. If the description and drawing are not such as might enable a skilful artist to construct the machine, you cannot find a verdict for the plaintiff.

The next question regards the utility of the plaintiff's alleged improvement. Upon this, also, you will pass as the evidence may direct you. If it be merely frivolous, or essentially pernicious, the law gives it no protection ; if, on the other hand, it be practical, and not injurious to the interests of society, a difference of opinion as to its degree of usefulness, as compared with other machines, will not affect the right of the patentees. On this point, the evidence of Mr. Phelps, Mr. Moore, Mr. Thomas, Mr. Towne, and others, will present itself to your minds as entitled to very great weight.

The issuing of the patent, upon the oath of the alleged inventors, is prima facie evidence of the novelty and originality of the invention. If, therefore, upon the points which I have mentioned, the conclusions to which your minds arrive shall be favorable to the plaintiff, it will remain for him to show that his rights have been infringed upon by the defendant.

There is no dispute of the fact that, since the issuing of the plaintiff's patent, and the vesting of the title in the plaintiff, and before the institution of this suit, the defendant did make a machine for Messrs. Wilcox, of Delaware county, of which the model is before you—and which machine was, and now is, in use for drying and finishing paper. If that machine was an infraction of the plaintiff's patent, the plaintiff has made out his case, and must have your verdict, unless the defendant can show good cause to the contrary.

Was, then, the machine, made by the defendant for Mr. Wilcox, an infraction of the plaintiff's patent,—or, in other words, is it or is it not, substantially and in principle, the same which is described in the plaintiff's patent?

In determining this question, you will have reference to the import of the plaintiff's specification, as it has been presented to you by the court. Is, or is not, the machine made by the defendant, "*a machine to finish paper, by the repeated contact of heated metallic cylinders acting, with graduated temperature and pressure, on the naked sheet, while damp, in successive stages of the drying process, alternately shifting the side next the drying cylinders?*" Is it substantially such a machine.

The question is not whether the two machines are identical in form, or whether they are equally perfect in their adaptation to use. It is the commonest of all devices, with those who seek to defraud a patentee, to give a novel exterior to their piracy, to modify forms, introduce new parts, or omit old ones, to change the position of the parts, and generally to mask their violations of the patent right as best they may. Sometimes the patent machine is made better by these variations, more frequently it is made worse. But all this is not of any moment to the discussion of an alleged infraction. Courts and juries look through the artifice of dress to the essential substance, and decide by reference to the substance alone.

This is the law in regard to combinations of machinery, as well as those which may be, in common language, spoken of as simple. All machines, for which a patent can be sustained, are, in truth, combinations of known elements; the only simple ones are those which we call the mechanical powers. The question, therefore, which you are to decide, is, whether there has been a substantial violation of the plaintiff's rights as the owner of the patented combination.

To determine this, you will compare the two machines, and will weigh the evidence of the different experts who have been examined; and having done this, you will apply the law, as laid down by the court, to your conclusions of fact.

The defendant's counsel has asked the court to charge you, that machines in which the drying cylinders do not touch, may be made without violating the plaintiff's patent. The court has no difficulty in so instructing you; regarding, as it does, the contact of the cylinders, except so far as they may be separated by the sheet which passes between them, as an essential part of the patented machine.

The court has been further asked by the defendant's counsel, to instruct you, that "making a machine with screws under the journals of the drying cylinders, so as to separate them, is no violation of the plaintiff's patent;" and "that if such a machine be made with screws under the journals, by which the drying cylinders may be kept apart, the machinist is not responsible for a violation of the patent right, although the purchaser should lower those screws, so as to allow the cylinders to come in contact."

The court is not aware that any evidence has been presented, to which the instructions asked for can properly have application. But inasmuch as the request addressed to it implies that, in the opinion of the highly respectable counsel, there has such evidence been adduced, the court will submit its views of the law on these points—the more readily, as the principles involved are, in its judgment, altogether elementary.

If the machine, as made by the defendant, was not an infraction of the plaintiff's patent, the alteration of it, by a third person, will not make the defendant liable for an infraction to which he was not a party. But if the machine, as made by him, was intended by him to operate in such a way as to violate the patent, and has, in fact, so operated, he was a party to the infraction, notwithstanding the ingenuity with which he may have sought to disguise his wrong. The introduction of screws under the journals, by which parts of the machine were for the time kept separated, which the purpose and uses of the machine required to be in contact, might be justly regarded by the jury as an illustration of this misdirected, and, in the result, profitless ingenuity.

So, the maker and vender of a patent lever watch, a combination of machinery, set in motion by a spring, and indicating the time of day by hands upon a dial plate, might infringe the patent for that in-

invention, though at the time of selling the machine, he had detached the hands from the dial, or omitted to wind up the spring.

The law would be valueless, if it could be eluded by devices like these. No machine maker, however determined to violate a patent right, would fail to leave some corner of his work unfinished, some spring unwound, some screw unadjusted, if, by so doing, he could escape the responsibilities, without impairing the profits, of his unlawful act.

The court submits to you the question, as one of fact, whether the defendant did make a machine similar in principle and substance with that of the plaintiff, as the court has defined it. If you find that he did, then the defendant is put upon his defence.

By the 15th section of the Act of Congress of 1836, the defendant, in an action like the present, is permitted to avail himself of various matters of defence, upon giving notice of them in writing to the plaintiff thirty days before the trial. Among these are included facts tending to show that the patentee was not the original and first discoverer of the thing patented, or that it had been described in some public work anterior to the supposed discovery thereof by the patentee. If, however, the defendant relies, under this section, on the fact of a previous invention, knowledge, or use of the thing patented, he is required to state in his notice of special matter, the names and places of residence of those whom he intends to prove to have possessed a prior knowledge of the thing, and where the same had been used.

In accordance with this section, the defendant, thirty days before the trial, gave notice, that the subject matter of the plaintiff's patent had been, before the time at which the patent issued, known to, and in use by, a number of persons, of whom eight were specified. No notice was given of an intention to show that the subject matter had been described in any public work before the plaintiff's supposed discovery; and no evidence, therefore, of such publication could be presented at the trial, unless by the plaintiff's consent.

Two or three books have, however, been read without objection, and are in evidence before you; and many witnesses have been examined to establish the prior knowledge and use of the machine. From all of these, the materials are presented in reasonable abundance to enable you to decide the great question of the cause, viz:—the novelty of the alleged invention.

It is not my purpose to recapitulate this evidence. The range of inquiry has been very broad; and very much of that which appeared pertinent when introduced, has been properly passed over in the argument without notice. The only machines which have been the subjects of much discussion before you, as of alleged similar character and prior date, are those of Howe, Carter, Ames, and Fisher. Upon each of these I shall make a few remarks, as introductory to certain instructions which it is my duty to give you on questions of law. For reasons not directly connected with this particular suit, it is my wish that, as far as may be practicable, the action of the jury on the merits of Knight's patent, shall be independent of any direct expression of opinion from the bench.

First, then, of Howe's machine. This has the merit, as compared with Knight's, of unquestioned priority of device and structure, and its appearance* certainly does not contradict its date. It consisted of a single pair of unpolished cylinders, heated by the rudest of all possible representatives of a steam boiler, without a safety valve, until the unconsidered contingency of an explosion suggested the substitution of hot bars of metal as a less dangerous resort. "That didn't answer, however, so well as the steam," and at last a common stove was introduced below the machine, one of the cylinders acting as a revolving smoke drum. It dried wrapping paper imperfectly—a thinner variety of coarse paper somewhat better, but not perfectly—and it would seem, that when the paper on which it was to act was thin, or less moist than common, or when the fire was good, and the potash kettle, which served for a boiler, had not been recently filled, it also pressed the paper without crushing it. It disappeared from the category of things in practical use and application, about the year 1837, when it was discarded by the proprietor, and has since remained in a lumber garret, till it came here for the purpose of this cause.

The rudeness of structure of Howe's machine, and the primitive character of its appliances, do not, however, necessarily indicate a difference of principle between it and a more highly finished specimen of art. Yet they may do so. For if the imperfection of its surface, and the want of precision in its adjustments, unfitted it altogether for the offices that are performed by Knight's machine, then it must follow that the object of Howe's machine was different, or that it failed to effectuate its object; and if so, it cannot be legally regarded as a machine known and used before the date of the patent.

It is for the jury, looking at the facts, to say whether this was a machine like Mr Knight's. Whether there was an alternating succession of drying and pressing, that repeated contact of cylinders, that graduation of the heat to the exigencies of the advancing stages of the process, which we observe in his. Whether, in a word, it was adapted to finish paper, or whether it necessarily left it unfinished and imperfect.

With reference, as we suppose, to this machine of Howe's, the court has been requested to instruct you, that "a mere repetition, or reduplication, of a machine known and used, cannot be the subject of a patent, merely because the same effect is increased."

The position is, in one sense, true. If it be intended to assert that a man who has no right to patent one machine, has no right to patent two of them, it may be conceded as indisputable. But if it be meant that a new and useful combination cannot be patented, because the parts which compose it are similar to each other, the court declines instructing you that such is the law. Nor is it, in the view of the court, an objection to the claim of a patent for such a machine, that it merely increases an effect which might be imperfectly produced by a more simple one; since it may be, and often is, the case, that the increased effectiveness of a contrivance constitutes all its value. The repeated reduplication of a feather makes the feather bed—the reduplication of patches, the quilt that covers it.

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* Referring to the machine itself in court.

We are further asked to instruct you, that "if Knight's machine is nothing but the use of two or three of Howe's machines, his patent is invalid." The answer of the court is embodied in the remarks just made.

Again, the counsel for the defence have asked us to instruct you, that "any use, however limited, of a machine similar in principle to the patented machine, will defeat the patent." As an abstract proposition, this is somewhat too broadly expressed, according to the best judgment of the court; but, if limited to the case under trial, it is certainly true that all four of the machines, which assert priority over Knight's have, according to the evidence, been so used as to invalidate his patent, if they, or either of them, can justly be regarded as the same substantially and in principle with his.

Taking these, as they appear to the court, upon the evidence, to have stood at the date of the plaintiff's patent, they may be described thus:

[The models and drawings of these several machines were before the jury.]

1. *Carter's.*—Consisting of several drying cylinders of the ordinary construction, heated by steam, not in contact with each other, with a small calender roller placed above one or more of them; the calender deriving heat only from the paper, which was itself heated by the drying cylinder, around which it passed; the paper not changing sides in its progress.

2. *Ames's.*—A single drying cylinder, of unusually large diameter, heated by steam, with a number of rollers of cloth, canvas, lead, iron, and paper, placed around it—some of them susceptible of graduated pressure, others so fixed as to be incapable of graduation. None of them heated except from the cylinder through the paper; the paper not changing sides in its progress.

3. *Fisher's.*—In which the paper passed over a heated iron drier, of some two feet diameter, between that drier and another of larger dimensions, also heated, and then around the larger drier.

If such be the evidence, of which the jury will judge, it would seem, 1. That in Carter's and Ames's machine, up to the time in question, the paper did not pass between heated cylinders at all, in that which may be regarded as the proper sense of the term, "heated cylinders;" for the rollers having no independent heat, but deriving all their heat from their contact with the paper, could never be hotter than the paper itself, and thus could not aid in drying it. 2. That in Carter's machine, if the testimony of Ayres and Lungren be correct, there was no successive pressure of heated cylinders; the contact, as in Howe's, occurring only once; and that the same is true as to Fisher's. 3. That in Ames's, though there was a succession of imperfectly graduated pressures, there could be no graduation of temperature, there being but one heated cylinder, from which all the rolls derived their heat. And 4. That in neither Ames's nor Carter's were the two sides of the paper presented alternately to the drying surface.

[These observations of the learned judge were incidentally explained by reference to the models.]

The court has indicated the particulars in which these several machines appear to it to differ from the machine of Mr. Knight. In so doing, it has not been our purpose to influence your action, but to make it more easy. You will decide, upon the evidence, whether these or any other differences exist in point of fact; and, if so, whether they are of form and proportion *only*, or of principle and substance also. If the machine devised by Mr. Knight is the same with either of those before known, this action cannot be sustained, and your verdict must be for the defendant.

Reference has been made, in the course of the trial, to a patent issued on the 8th of September, 1824, to Isaac Burbank, for an improvement in paper making, called the revolving mould. The patent itself is for an invention altogether unlike that which is here in controversy; but it is contended that Mr. Burbank has in his specification described an apparatus similar in principle to Knight's drying machine, without, however, claiming it as part of his invention. There is no proof whatever that Burbank ever made or used the machine which he so described, or that Knight ever saw or heard of the description; and the Patent Office having been burnt some three years before Knight's patent was applied for, and Burbank's patent not having been since recorded anew, there is no ground on which an inference of fact, still less a presumption of law, can rest adverse to the originality and integrity of Knight's invention. Independent of all which, the court does not feel itself justified in instructing you, that a man who patents his invention is bound to take notice, at his peril, of all that all prior patentees have seen fit to mix up with the specifications of their supposed inventions. It is enough, in all reason, for any one mind to inform itself of all the supposed inventions really patented, with their appropriate specifications.

The descriptions and drawings in the books which have been read to you, will next claim your attention. In examining them you will be careful to ascertain whether the machine for which a patent is here claimed, and not some other, differing either in its essential structure or purpose, has been the subject of description. If the plaintiff's machine had been described in some public work anterior to his supposed discovery, he cannot recover in this action.

If, on the other hand, you shall be of opinion that he, and those to whose rights he succeeds, were really the inventors of the improvement for which he holds a patent; that he has not sold his legal interest, or any part of his legal interest, in the patent; that the invention has been honestly and adequately set forth in his specification and drawing; that it is useful; and that the defendant has made and sold a machine which is substantially and in principle the same as his; in such case, your verdict will be for the plaintiff, and you will proceed to inquire what damages he has sustained.

The measure of damages, in a case like this, can scarcely be defined in precise terms. They should be compensatory, not vindictive. The object is not punishment, but it is full indemnity. The amount of profit which the defendant has derived from the infraction, is one of the elements to be regarded; but the amount of loss and injury which the plaintiff has sustained, should be regarded also. Among other things, the expense and toil incident to the prosecution of a suit like this, ought to be fairly considered; the plaintiff ought not to be made a loser by the assertion of his rights. In the words of the law, your verdict will be for such an amount as you believe to be "the actual damages sustained by the plaintiff."

The counsel for the parties respectively have asked the court to instruct you on several legal questions. Some of them have been already adverted to. On the rest, we will now advise you, according to our best judgment.

So far as the plaintiff's points have not been answered, the jury are now instructed as follows:

1. If the terms of art contained in the specification are ordinarily used and applied as testified, and if the jury believe that the varying texture of the damp sheet during the drying process, as described by the witnesses, renders such repetition of contact of the driers, as is described in the specification, a process adapted to the successive conditions of the sheet, and useful in converting it into finished paper in the manner testified, the plaintiff's interpretation of the specification is correct in point of law, and his patent is valid, if original.

2. If the machines designated as Carter's, Howe's and Fisher's, respectively, operated, as has been testified, without successive graduation of either heat or pressure, neither of these machines was identical with the subject of the plaintiff's patent.

3. If the machine designated as Ames's was constructed as has been testified, the impossibility of successive graduations of temperature at the respective stages of dampness of the paper at which the sheet underwent pressure, and the incapacity of the machine to admit of a change on the side next to the drier, during the continuance of the process, render this a different machine from that which is the subject of the plaintiff's patent.

Of the defendant's points, the 7th, 8th, 9th, 12th, 13th, and 14th have been answered by the court in the charge already given. The 18th has also been answered, so far as it regards the case. The 1st. 2nd, 3d, and 15th points are answered in the affirmative. So, also, is the 4th, meaning, of course, the owner of the legal title; for, whatever may be the equitable rights of others, the legal owner may maintain suit.

The remaining points of the defendant are answered as follows:

5. It is evidence to go to the jury, with the other evidence that leads to the opposite conclusion. It is not conclusive: the jury are to say whether plaintiff sold to a third person, or took to himself at the appraised value: unless he sold to a third person, the action is well brought.

6. *Answered in the affirmative;* but a substantial violation is enough: the forms and proportions are not essential.

10. The court has construed the patent in the charge, and has nothing to add to what has been said.

11. His patent is not invalid on the supposition which the point presents, if the plaintiff's combination of machinery for that purpose was new.

16. Not so. The combination stated is for drying and pressing, "*as described*" in the specification, and the patent is coextensive with the specification.

17. Not so. If the patent was not on record, or known to him before his patent, it does not *per se* invalidate his patent, as to a matter not patented in the previous patent, or claimed in it as an invention of the patentee.

18. Answered in the charge, so far as it regards the case.

19. The defendant's counsel having explained this by reference to the 9th section of the Act of Congress of 1837, contends that the words "*thing patented,*" as there used, cannot, in any case, be applied to a *combination.* The instruction, as requested, is refused.

20. If the machine was never used, the damages should be merely nominal, as against the maker; if it has been sold by him and used by others, the verdict should be for the damages actually sustained by the plaintiff, without exclusive reference to the profitableness of the use by the wrong doer, or the length of time such use may have continued.

The jury found a verdict for the plaintiff. Damages $1500.*

BIBLIOGRAPHICAL NOTICE.

The Law of Patents in Foreign Countries. Translated by R. W. Urling.

We have received of C. S. Francis & Co., of No. 252 Broadway, New York, a copy of an English work, in one octavo volume of 277 pages, entitled "The Law of Patents in Foreign Countries, translated, with notes, for the information of inventors and patentees, by R. W. Urling, of Brussels, Patent Agent." We consider this book to be a valuable addition to our library, and are pleased to learn that a number of copies of it have been imported for sale, by Francis & Co. It contains clear and plain expositions, in the English language, of the patent laws of France, Belgium, Holland, Prussia, Austria, Russia, and other European countries; together with judicious advice to inventors and patentees. Much valuable information is brought together, in a small compass, from various sources, and it is so arranged as to be easy of access. So many important inventions and improvements are made by our countrymen, which are afterwards brought into use in Europe, that a knowledge of the means by which a share of the profits of them may be secured to their originators is of great consequence. From the book before us, that knowledge may be obtained. The intercourse between Europe and America increases every year; new lines of packet ships and of steamers are established, and business relations are more and more extended. The constantly increasing stream of emigration multiplies the ties between the old and new worlds, and a generous rivalry in the arts of peace is characteristic of the age. Improvements in railroad machinery made in this city are now introduced extensively in Europe, and especially in Russia, and fire engines, of the admirable description used in Philadelphia, are about to be built at St. Petersburg. The accounts of American patents contained in our journal attract much attention abroad, and we think that the means of securing patents in foreign countries is a subject well worthy to be studied by our inventive fellow citizens.

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* After the verdict, Mr. Wilcox, for whom the machine which formed the subject of controversy had been *made* by the defendant, paid $500 to the plaintiff: who, for this consideration, executed to him a release of his liability, in damages, for having *used* this machine, and another one, made by another machinist, on the principle of the patent—with a grant of the privilege of the future use, by Mr. Wilcox, of the *same two machines.*

The Art Union Monthly Journal.

We have received "the Art Union Monthly Journal of the Fine Arts" up to the number for May, 1847. This periodical is published in London, in quarto form, price eighteen pence, and a new and enlarged series began with the present year. It is devoted to the advancement of the fine arts, especially as connected with the useful arts and the various manufactures which are capable of embellishment. The illustrations are numerous and beautiful, comprising both wood-cuts and engravings of a high order of excellence. The whole range of art, from the highest to the lowest, comes within the scope of this journal, and the amount of information which it gives on such subjects can only be appreciated by examining its pages. Its articles on the manufactures of Great Britain are instructive and elaborate, and its suggestions for their improvement are characterized by sound judgment and good taste. The progress of art on the continent of Europe, and particularly in France and Germany, receives much attention, and the latest intelligence on the subject is laid before the English reader. The Art Union Journal is a strenuous advocate for the extensive diffusion of the best designs among all classes, at a cheap rate, so as to cultivate, elevate, and purify the taste of the public at large; and the journal itself is one of the most efficient means of promoting that end.

When such great efforts are made abroad to give to manufactured articles that additional value which is conferred upon them by purity of design, justness of proportion, and good taste in ornament, it is of high importance to American manufacturers that they should not be behind in the race of improvement; and the extensive circulation, among them, of the journal before us, would be of much service in many respects. We cordially commend the work as one well worthy of high praise.

MECHANICS, PHYSICS, AND CHEMISTRY.

Armament for War Steamers.

The Lords Commissioners of the Admiralty, after considerable experience of the power of the various steam frigates and other steamers in the Royal Navy, as regards their capabilities of bearing heavy armaments, have resolved to fix the following as the armament of each particular steamer. Vessels of similar, or nearly similar, tonnage and horse-power, are to be arranged in classes:—

Steamers Propelled by Paddles.

Steam Ships.—Terrible, 1850 tons, 800 horse power; main deck: four 56-pounders of 97 cwt., 11 feet in length; four 8-inch guns of 65 cwt., 9 feet; the 56-pounders on pivot slides, and carriages; the 8-inch guns on common carriages—upper deck: four 56-pounders of 97 cwt., 11 feet, on pivot slides and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on common carriages: total guns, 16. Penelope, 1616 tons, 650-horse power; main deck: eight 8-inch guns of 65 cwt., 9 feet, on slides and carriages; two 68-pounder carronades of 36 cwt., 5 feet 4 inches, on Hardy's compressor carriages—upper deck: two 68-pounders of 95 cwt., 10 feet, on pivot slides and carriages; four 8-inch guns of 65 cwt., 9 feet, on slides and carriages: total, 16. Retribution, 1641 tons, 800-horse power; main deck, none (but it is arranged that all steam ships which do not carry an armament on the main deck shall, if possible, carry four 32-pounders of 56 cwt., for head and stern firing)—upper deck: two 68-pounders of 95 cwt., 10 feet, on slides and carriages to pivot; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages: total, 6.

Steam Frigates.—Class 1. Avenger, 1444 tons, 650-horse power; and Birkenhead, of 1400 tons, 500-horse power. Upper deck: two 68-pounders of 95 cwt., 10 feet, on slides and carriages to pivot; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages; total, 6. At present the Avenger carries, by way of experiment, two 32-pounders of 65 cwt., instead of two of the 10-inch guns.—Class 2 (A). Odin, 1326 tons, 500 horse power. Main deck: six 32-pounders, 56 cwt., 9 feet 6 inches, on common carriages. Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages; total, 12. The steamers also belonging to this class are the Sidon and the Leopard. Class 2 (B). Gladiator, 1210 tons, 430-horse power; Sampson (450-h. p.); Centaur (540-h.p.); Dragon (560-h.p.); Firebrand (400-h.p.); Vulture (400 h.p.); and Cyclops (320-h.p.). Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides and carriages; four 10-inch guns, of 85 cwt., 9 feet 4 inches, on slides and carriages; total, 6.

Steam Sloops.—1st class, Gorgon, 1111 tons, 320 horse power; Bull-dog (500), Fury (515), Inflexible (378), Devastation (400), Sphynx (500), Cormorant (300), Thunderbolt, since wrecked in Algoa Bay, (300), Virago (300), Eclair (287), Driver (280), Geyser (280), Growler

(280), Styx (280), Vixen (280), Spiteful (280), Stromboli (280), and Vesuvius (280). Upper decks: one 68-pounder of 90 or 95 cwt., 10 feet, and one 10 inch, 85 cwt., 9 feet 4 inches, on pivot slides and carriages. Four 32-pounders of 42 cwt., 8 feet, on Hardy's slides and carriages. Total, for all vessels of this class, 6.—2nd class: Medea, 835 tons, 350 horse power, Salamander (220), Hydra (200), Hecate (240), Hecla (240), Hermes (220), and Trident (350). Upper deck: two 10-inch guns, 65 cwt., 9 feet 4 inches, on pivot slides and carriages. Four 32-pounders, 25 cwt., 6 feet, on Hardy's compressor carriages. Total, 6.—3rd class: Ardent, 810 tons, 200 horse power, Alecto (200), Polyphemus (200), Prometheus (200). Upper deck: one 32-pounder, 45 cwt., 8 feet 6 inches, on pivot slides and carriages. Total, 3. A special exception is made in this class of the Janus, 763 tons, 220 horse power, which carries only two 10-inch guns of 85 cwt., 9 feet 4 inches, on pivot slides and carriages.

Bomb Steamers.—Scourge, 1124 tons, 420 horse power; upper deck, one 68-pounder, 95 cwt., 10 feet, on slide, and carriage to pivot; one 13-inch mortar; total, 2.

Steam Gun-vessels.—Class 1. Firefly, 550 tons, 220 horse power, Blazer (126), Tartarus (136), and Flamer (120). Upper decks: one 32-pounder, 42 cwt., 8 feet, on slide and carriage to pivot. Two 32-pounder carronades, 17 cwt., on Hardy's carriages.—Class 1 (A). Grappler 559 tons, 220 horse power, Pluto (100), Colombia (100), Oberon (260), Triton (260), Antelope (260), Acheron (170), and Volcano (140). Two 32-pounders, 56 cwt., 9 feet 6 inches, on slides and carriages to pivot; two 32-pounders, 25 cwt., 6 feet, on compressor slides and carriages; total, 4.—Class 2 (A). Spitfire, 432 tons, 140 horse power, Porcupine (132), Lucifer (180), Avon (170), Gleaner (130), Shearwater (160), Kite (170), Lightning (100), Meteor (100), and Comet (80). One 18-pounder of 20 cwt., 7 feet, on slides and carriages to pivot; two 18-pounder carronades, 10 cwt., 7 feet, on Hardy's compressor carriages; total, 3.—Class 2 (B). Torch, 345 tons, 154 horse power, Locust (100), Harpy (200), Jackal (150), Lizard (150), Bloodhound (150), and Myrmidon (150). One 18-pounder gun of 22 cwt., 7 feet, on pivot slide and carriage, and two 18-pounder carronades, 10 cwt., 7 feet on Hardy's carriages.

Steam Packets.—Wildfire, 186 tons; Fearless, Dasher, Monkey, and Dwarf. Two 6-pounder brass guns of 6 cwt.

Tugs.—Echo, 295 tons, 140 horse power, African, and Confidence. Two 32-pounders of 56 cwt., 9 feet 6 inches, on pivot slides and carriages.

Troop-ships.—Rhadamanthus, 813 tons, 220 horse power; Dee (220), and Alban (120). Four 32-pounders of 42 or 56 cwt., 8 feet, on common carriages.

Steamers Propelled by Screws.

Steam Frigates.—Class 1. Simoom, 1953 tons, 780 horse power. Main deck: twelve 32-pounders, 56 cwt., 9 feet 6 inches, on slides and carriages. Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages. Total, 18. Vulcan, 1747 tons, 700 horse power. Main deck: eight 32-pounders, 56 cwt., 9 feet 6 inches, on slides and carriages. Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides and carriages; four 8-inch guns, 65 cwt., 9 feet, on slides and carriages. Total, 14. Termagant, 1556 tons, 620 horse power; Dauntless, 520; Euphrates and Vigilant, 520. Main deck: eighteen 32-pounders, 56 cwt., 9 feet 6 inches, on common carriages. Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages. Total, 24.—Class 2. Megara, 1391 tons, 556 horse power, and Pegasus, 510. Main deck: four 32-pounders, 56 cwt., 9 feet 6 inches, on slides and carriages. Upper deck: two 68 pounders, 95 cwt., 10 feet, on pivot slides and carriages; four 8-inch guns, 65 cwt., 9 feet, on slides and carriages. Total, 10.

Steam Sloops.—Class 1. Conflict, 992 tons, 400 horse power, Desperate, Niger, Enchantress, Falcon, Basilisk, and Florentia. Upper deck: one 68-pounder, 95 cwt., 10 feet; one 10-inch gun, 85 cwt., 9 feet 4 inches, both on pivot slides and carriages; six 8-inch guns, 65 cwt., 9 feet, on slides and carriages; total, 8. Class 2. Encounter, 895 tons, 360 horse power, and Harrier. Upper deck: one 68-pounder, 95 cwt., 10 feet, and one 10-inch gun, 85 cwt., 9 feet 4 inches, both on pivot slides and carriages; four 8-inch guns, 65 cwt., 9 feet, on slides and carriages; total, 6.—Class 3. Rattler, 888 tons, 200 horse power, and Phœnix, 260; one 8-inch gun, 65 cwt., 9 feet; one 32-pounder, 56 cwt., 9 feet 6 inches; four 32-pounders, 25 cwt.. 6 feet, on pivot slides and carriages, or otherwise, if necessary; total, 6.

Steam Gun-boats—1st class. Rifleman, 483 tons, 202 horse power, Sharpshooter, Archer, Parthian, Sepoy, and Cossack; one 68-pounder, 95 cwt., 10 feet, and one 10-inch gun, 85 cwt., 9 feet 4 inches, on pivot slides and carriages; two 32-pounders of 25 cwt., 6 feet, on Hardy's carriages; total, 4.—2nd class. Teazer, 301 tons, 100 horse power, Minx, Boxer, and Biter; one 8-inch gun, 65 cwt., 9 feet, on pivot slide and carriage; one brass 6-pounder; total, 2.

Steam Guard-ships, with Auxiliary Power.—Edinburgh, 1772 tons, 450 horse power, Ajax, Blenheim, and La Hogue. Lower deck: twenty-six 42-pounders, 66 cwt., 9 feet 6 inches, on common carriages. Quarter-deck: two 56-pounders, 87 cwt., 10 feet, on pivot slides and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages. Forecastle: two 56 pounders, 87 cwt., 10 feet, on pivot slides and carriages. Total, 56 guns.—Eurotas, (fr.,) 1168 tons, 350 horse power, Horatio, Seahorse, and Forth. Main deck: twenty 42-pounders, 66 cwt., 9 feet 6 inches, on common carriages. Quarter-deck: one 56-pounder, 87 cwt., 10 feet, on pivot slide and carriage; two 8-inch guns, 65 cwt., 9 feet (or two 10-inch guns of 85 cwt., 9 feet 4 inches), on slides and carriages. Forecastle: one 56-pounder, 87 cwt., 10 feet, on pivot slide and carriage. Total, 24.

Steam Frigates with Auxiliary Power.—Arrogant, 300 horse power. Main deck: twenty-two 32-pounders, 56 cwt., 9 feet 6 inches, and six 8-inch guns, 65 cwt., 9 feet, on common carriages. Quarter-deck: one 68-pounder, 90 or 95 cwt., 10 feet, on pivot slide and carriage; sixteen 32-pounders, 32 cwt., 6 feet 6 inches, on Hardy's carriages. Forecastle: one 68-pounder, 90 or 95 cwt., 10 feet, on pivot slide and carriage. Total, 46.—Amphion, 300 horse power. Main deck: fourteen 32-pounders, 56 cwt., 9 feet 6 inches, and six 8-inch guns, 65 cwt., 9 feet, on common carriages. Quarter-deck: one 68-pounder, 90 or 95 cwt., 10 feet, on pivot slide and carriage; eight 32-pounders, 25 cwt., 6 feet, on compression carriages. Forecastle: one 68-pounder, 90 cwt., 10 feet, on pivot slide and carriage. Total, 30.

This return does not include the numerous packets that ply as mail steamers on the various stations round the coast and in our colonial possessions. Civ. Eng. & Arch. Jour.

Copper Wire Rope Lightning Conductors.

(With a Plate.)

Sir,—I herewith send you an abstract sketch and description of my Patent Copper Wire Rope as Lightning Conductors, and ordered to be adopted in the Royal Navy, of which a considerable number of ships have been fitted, besides a much greater number in the merchants' service; the advantage of these conductors consists in their efficiency, economy, and easy application—the perfect continuity, by means of the copper wire line, from the *truck a*, plate v, figs. 6 and 7, at the top-gallant mast-head, passing down the top-gallant mast—then down the *after* top and lower mast shrouds to *c*, below the waterline, as shown on the sectional sketch, which carries the electric fluid clear off the ship, into the water, without injury; the time required for fitting a ship with this conductor is only a few hours, and the expense, including the fitting, is 9d. per foot; if all three masts are fitted, the expenses are about 12*l.* for large class ships—if mainmast only, under 5*l.*—small vessels less in proportion.

The accompanying testimonials, from amongst several, will satisfy you of the efficiency of these conductors:—

Liverpool, August 20, 1842.

Sir,—I have used your Patent Copper Wire Rope Lightning Conductors for three years, and approve of them; the ship I command was struck laying in New York—the electric fluid passed down the conductor to the water, without injury to the spars or hull.

(Signed) J. C. Delano,
Commander of the ship *Patrick Henry.*

Mr. Andrew Smith.

The following is an explanation of the mode adopted in her Majesty's Navy, for the application of Andrew Smith's Patent Copper Wire Rope, as Lightning Conductors, as issued from the Admiralty, Somerset House:

"*Instructions for Fitting Ships of War with Copper Wire Rope, as Lightning Conductors.*—From the truck to the cap of the lower mast-head a wire rope conductor, of three-eighths of an inch in diameter, is to be fitted, secure to the truck, as at *a*, leading down the topmast shroud to the lower mast-head, and in contact with the after shroud, to the link of the dead eye and ship's side, *d*, whence it is connected to a copper-plate (fig. 8) of 2½ inch broad, three-sixteenths of an inch thick in the middle, rounded off at the edges—inserted into the ship's side; care is to be observed that the edges are well let into the wood, and that the plate is brought into close contact with the copper sheathing on the ship's bottom, extending, at least, to the depth of one sheet below the water-line. The top-galiant mast is to be so fitted with the truck, as to admit of its being struck without the removal of the conductor from aloft, as it may be coiled and left at the top-mast head while the mast is on the deck. The flying jib-boom is not to be fitted in any ship—and in smaller vessels (single deck) the bowsprit need not be fitted."

The annexed certificate has been received from Capt Crawford:—

"The ship *Blakely*, of Liverpool, belonging to Messrs. Taylor, Potter, & Co., left Liverpool in the month of February, 1841, bound to China, fitted with your Copper Wire Rope Lightning Conductor on the main-mast, from the main-top-gallant-mast-head down to the main rail, and from thence to the copper. The captain was made acquainted that the main-mast was protected, but the royal-mast *was not*—and for him, the first opportunity he had, to put the copper wire rope from the conductor to the truck, which he did not do. When the ship arrived off Java Head, she encountered a severe storm of thunder and lightning, which struck the main-royal-mast, and shivered it all to pieces; the lightning then descended by the conductor into the water, to the astonishment of all on board—doing no other damage to the ship. I am happy of having an opportunity of making you acquainted with the circumstances. I hope it will stimulate other ship owners to imitate the house of Messrs. Taylor, Potter & Co., whose ships have all been fitted by me with your Copper Wire Rope Lightning Conductor."

ANDREW SMITH.

Patent Galvanized Iron and Wire Rope Works, Millwall, Poplar, Jan. 27.

Lond. Min. Jour.

Gases and Explosions in Collieries.

Continued from Page 363.

The Committee of 1835 pointed out that more persons had lost their lives from colliery explosions for the 18 years succeeding the introduction of the Davy safety lamp in 1816 than in the 18 years preceding the invention, and accounted for this fact by the working of numerous "fiery" seams of coal, which had, in consequence of the assumed security of that lamp, been undertaken, and by the abandonment of many precautions considered requisite when candles were commonly employed in collieries.

As much doubt has been thrown upon the real safety of the Davy lamp, it is but justice to the memory of Sir Humphrey Davy to state that he was perfectly aware that, if a proper mixture of fire-damp and common air were thrown against the lamp with sufficient force to project the flame upon the gauze cylinder, it might communicate with the flame, and cause explosion. Mr. Buddle, in his evidence (Report of Committee of 1835, Nos. 2226 and 2227), clearly shows this to have been the case. He mentions an experiment at Morton West Pit, where a very powerful blower from the shaft was tried with the lamp, when the flame passed and the blower was fired. Sir Humphrey Davy then, addressing Lord Durham, and many other persons who were present, said, "Now, gentlemen, you see the nature of the danger to which you are exposed in using the lamp, and I caution you to guard against it in the manner I have shown you. This is to show the only case in which the lamp will explode; and I caution and warn you not to use it in any such case when you can avoid it without using the shield." The shield recommended was one of tin, inside the cylinder, to prevent a current of fire-damp from acting on the flame. Mr. Buddle stated before the Committee that, in the lamps used in the collieries under his management, the shield, passed from one-half to two-thirds round the inside of the cylinder, and, being bright, reflected the light to such an extent as to be more advantageous than a glass cylinder inside that of wire gauze, a contrivance often recommended to obviate the risk of currents of firedamp.

Dr. Pereira, at the request of the Committee of 1835, experimented upon many lamps before them, and passed the flame through all those tested, except that of Messrs. Upton and Roberts. The experiments have been repeated at the Museum of Economic Geology, by Dr. Pereira and by ourselves, with the ordinary Davy lamp, and with the same results.

There can, therefore, be very little doubt that the flame can pass, and explode fire-damp adjacent, if the current be sufficiently strong, and no protection be afforded either by a metallic shield or by an internal glass cylinder. The question as to the amount of current required seems not so well ascertained. Mr. Buddle considered that the blowers would rarely be found strong enough. Mr. Stephenson supposed that many accidents may have happened by the falling of the roof producing a sudden rush of explosive fire-damp. It will be obvious that the same effect might be produced by the careless swinging of the lamp with the required velocity through an explosive mixture of fire-damp and air, or from the lamp being so jerked out of a collier's hand, by an unlucky fall, that the cylinder presented the necessary front to the same compound.

Without desiring, in the slightest degree, to cast unnecessary doubt on the safety of the Davy lamp, since we consider its cautious use an immense boon to coal mining, and believe that much additional security is obtained by the proper use of the original Davy, or of its improvements, it can scarcely be denied that far more care in the use of safety lamps is needed than is commonly employed. Although shields or glass cylinders are used in some localities, they are never employed in others; and the bare single cylinder of wire gauze, not always properly manufactured, is the only form in which the Davy lamp is known. And it should be observed that, with a few local exceptions, the Davy amp is that commonly employed. Numerous modifications, and in some cases improvements, of the safety lamp have been made, but, either from the expense, or want of simplicity in management, have never come generally into use.

The colliers, by their usual mode of carrying the common Davy lamp, certainly, under ordinary circumstances, guard against the passage of any current of fire-damp sufficiently strong to pass the flame, by placing the lamp within their jacket flaps, or carefully protected in some other manner. Abundant carelessness is often, however, apparent; and, when the collieries are viewed as a whole, unnecessary risk is too common, especially when it is recollected that the fool-hardiness or carelessness of one may destroy the lives of many.

To those who have, during many years, had occasion to visit collieries in different parts of Great Britain, the thoughtless daring of many of our colliers, and their frequent carelessness under danger, must be familiar. They will often, in an endeavor to execute more work in a given time, when paid by the ton or piece, remove the covers of their lamps, or employ a candle at a risk. Some even prefer a candle to ascertain the presence of fire-damp, since by it they more readily see the change in the flame. In many districts, though in some they are anxious to employ the safety lamp, it requires much trouble on the part of managers to prevent the continued use of candles in suspected places before the danger becomes known to them. The less light afforded by lamps is considered a great drawback to their use when it can be avoided. Many most careful men, no doubt, anxiously watch over the common danger, and great precautions are taken by many coal owners and workers; but looking at the subject generally, and without reference to many exceptions, especially to be found in the north of England, the want of system in the management of lights, and in due precautions respecting the kinds employed, can scarcely escape the observation of those whose opportunities have been sufficiently extended.

When we consider that the safety lamps have now been in use for so many years, causing security in all cases where proper care is employed, although they may not be absolutely safe under unusual circumstances, their utility appears sufficiently sanctioned by experience to make them the subject of legislative enactment. The evils complained of in the modifications of the Davy lamp are, that, while they add to the security, they diminish so much the amount of light, as to render them practically useless. These are described in the report of the Select Committee referred to. A new modification of Dr. Clanny's lamp, invented since then, is not subject to this fault, and in principle is an elegant application of the safety lamp, and consists of a wire-gauze cylinder, having beneath a thick glass cover to the lamp, which only ascends till it meets with the gauze; the thickness of this glass is supposed to free it from accidents, and, whilst strong enough to bear a considerable blow, it is sufficiently well annealed to resist sudden changes of temperature. But whether, in a manufacture so uncertain as glass, these conditions can always be attained, is questionable, and at all events has not been sufficiently tested by experience to induce the coal owners to employ this lamp in their mines.

It has been at various times proposed, during the last eight years, to employ electricity as a means of lighting collieries. The electricity, streaming between two charcoal points from a Grove's or a Bunsen's battery, affords a light of much beauty, and perfectly safe if completely surrounded by glass, but capable of igniting an explosive mixture if exposed. Professor Grove has constructed a lamp on this principle, which he kindly prepared for us, and which we have examined in action. It consisted of a box, containing four galvanic cells, and the light was obtained by the passage of electricity between two coils of platinum wire. These were surrounded with glass vessels; the inner one for the purpose of isolation, the exterior one being filled with water, so as to destroy the light, should the inner glass vessel be broken. The light given out was rather more than that of a miner's candle. This, certainly, is a safe lamp, but in its present state still unfitted for the purpose of the collier as at present arranged. The acids, sulphuric and nitric, render the lamp so inconveniently heavy, that both hands must be used in carrying it; besides, from not being covered, the spilling of these corrosive liquids on the persons of the miners could scarcely be avoided. The water in the external vessel soon becomes heated, and ultimately boils, and the light only lasts in proper strength for two or three hours. There must, therefore, be considerable modification in this lamp before it can be rendered available for ordinary mining purposes, which we may readily expect, from the acknowledged talent of its inventor.

The means of obtaining the needful lights in collieries, though most important, would still appear subordinate, as has, indeed, been before remarked, to such a system of ventilation as should not expose men in such large portions of a colliery as is now frequently the case, to the risk of death from explosion, (the greater proportion, and often all, perishing from the carelessness of one man,) or to unforeseen accidents under the greatest precautions in the use of lights. The too common use of single shafts in collieries, in cases where others might have been sunk, the single shaft divided into two or three portions by wooden partitions named *brattices*, a down current of pure air descending through one division, and the foul air from the colliery workings rising up through another, has often been reprobated. The Committee of the House of Commons of 1835, and many important witnesses examined, animadvert upon this practice; and the bad effects of this system are pointed out by the South Shields Committee in their report of 1843.

In a single shaft, as has often been remarked, the ventilation may be cut off from the workings of a whole colliery in an instant by an explosion sufficient to destroy the doors or partitions directing the air-courses, the air merely going down one division in the shaft and rising through another, when the brattices may not be destroyed by the explosion, and a kind of draught kept up. Thus all not destroyed by the explosion perish in the mixture of nitrogen and carbonic acid, known as after-damp, to which no fresh air can reach. In the explosion at Jarrow Colliery there was only a single shaft communicating with the workings upon two beds of coal one above the other, and the lower part of the brattice in the shaft was so shattered by the late explosion in it, that Dr. Playfair and Mr. Williams, in their descent into the pit, then containing a large amount of fire-damp, had to be let down a considerable distance by a loop in a rope. In this explosion the upper portion of the brattice fortunately remained, and thus the lives of many of those engaged in the upper workings were saved, although several perished.

Even in a double shaft, or two shafts not far distant from each other, if the air be not made to course for a considerable distance amid the workings by a firm thick parting of coal, any needful perforation in the parting for the progress of the colliery being firmly built up, a whole mass of workings may, by an explosion, be suddenly cut off from ventilation, and numbers of persons, not killed by the explosion, perish by the after damp. This was the case at the late explosion at Risca. It should, however, in this instance, be observed, that the colliery was, as regards ventilation, in a transition state, a more perfect arrangement for ventilation being in progress.

Great improvements were introduced in the ventilation of collieries in many districts, when the course of air was quickened by means of a furnace established near the bottom of the upcast shaft, or that through which the foul air passes outwards, and more particularly when, in the north of England, instead of permitting the air introduced by the downcast shaft to pass slowly and imperfectly along a course of 20 or 30 miles of passages, it was split or divided into separate courses, from two to six miles in length. Those, however, who may possess an extended acquaintance with our collieries in different parts of the country cannot but be aware, that, as a whole, their general ventilation is very imperfect, good as it may be in some collieries, particularly in some districts.

When it is considered that coals are worked in the United Kingdom under every variety of condition,—from levels driven into mountain sides to pits sunk to great depths through masses of superincumbent rocks,—in beds ranging from a vertical to a horizontal position, and even contorted and bent,—sometimes traversed by faults, at others free from them,—the beds near the surface in one place, and ranging beneath mountains in another,—in fact, under a great variety of geological conditions, it is not difficult to see that many plans which have been suggested for the working of collieries, good as they may be for some localities, would be inapplicable generally, and would indeed fail, except under the conditions fitted for them.

So various are the conditions under which collieries are or can be worked in the United Kingdom, that we would suggest for consideration, if legislative measures should be deemed advisable, and an extension of the principle which regulates the employment of women and children in our mines, and the labor in our factories, be thought good, that effective discretionary powers should be vested in properly qualified persons, appointed in convenient districts, so that the needful adjustments to conditions may be effected, and no single system be attempted inapplicable to our collieries as a whole.

Any general system of legislation for conditions so different could only be productive of failure or of injurious consequences, both to owners and workers; but a local examination and inquiry, with power to adjust to special conditions, would, we apprehend, remove the difficulties which the legislature has felt in dealing with interests so important.

Jealous as the coal owners should properly be of any undue intermeddling with their collieries, it may nevertheless be true that a judicious system of superintendence in a district, by which the proper ventilation of collieries, efficient knowledge on the part of subordinate agents, and proper punishment for fool-hardiness or carelessness on the part of the colliers may be secured, would be a great advantage to them individually and collectively, and be the saving not only of lives but of much capital, securing them, in the case of accidents, from many an unjust accusation for neglect.

On the other hand, careful but not overmeddling supervision would afford confidence to the collier. Proper persons being appointed as superintendents, (and, if improper, their deficiencies would soon become apparent, and their removal the consequence,) he would feel that he has the advantage of the existing knowledge of the day brought to bear upon the particular conditions under which the colliery in which he labors is worked. In some districts the working collier is far better informed upon the general principles which should receive attention than may be commonly supposed, and he would feel far more secure from danger than he now does, if assured that the State was not neglectful of his safety.

Though several collieries in particular districts possess good plans and sections of their workings, and an inspection of such plans and sections affords a view of the system of ventilation and general mode of working adopted, this is far from being the case generally, and has been much regretted alike by the enlightened coal owners and by the public. The importance of correct plans and sections has been prominently pointed out, both by the Committee of the House of Commons of 1835, and in the report of the South Shields Committee of 1843; indeed, the necessity of them is sufficiently obvious.

Should the suggestion of a system of judicious inspection be considered worthy of consideration, the ready access to proper plans and sections of collieries, brought up to given times, would necessarily form a part of any general system of regulations. If correct, (and power to ascertain that they were so would be essential,) they would at once disclose the system of working and ventilation adopted, and, with information respecting the police regulations, and an account of the kind of lights employed, would at once afford a general view of the mode of conducting any particular colliery, and of the adjustment of the workings to conditions.

It being considered that safety lamps, properly used, do effect much security in the working of coal, and that in so many cases explosions do take place when they are not employed, it has often been suggested that the Legislature should compel the general use of safety lamps in coal mines. But, on the other hand, there are many collieries in which fire-damp never appears, and it would justly be considered a hardship in such cases to compel a precaution altogether unnecessary.

We would suggest that it could not be considered unjust for the Legislature to compel the use of safety lamps in all fiery collieries; and, in the present state of the law of property, it might even be prudent to assume that all collieries, in districts where explosions have been frequent, are fiery, putting the *onus probandi* that they are not, upon the owners of such collieries. If proved to the satisfaction of the inspectors that no reasonable danger was to be apprehended in their collieries, license might be given for them to work with naked candles, this license ceasing at short periods, but being renewable on ascertaining that the conditions of the mine had not altered.

Careful investigations into the causes of explosions in collieries, only part of which arrest public attention by their magnitude, appear to have led to the very general conclusion that the condition of our collieries is most unequal. While, in some localities, there is so little to improve that it becomes a subject of regret that such examples should not more generally be followed, in others it becomes a matter of surprise how the works can be permitted to remain in so defective a state, seeing that the owners themselves suffer much loss thereby. Under such a state of things, and considering the number of valuable lives annually lost by colliery explosions, the continued risk to which so many are daily exposed, the national injury sustained by the imprudent and careless mode of extracting coal in many localities—one often felt oppressively, also, by the parties engaged in colliery speculations—and that the workings for coal must be adjusted to local conditions, we are led to consider that these evils might be at least mitigated by the careful and judicious inspection of convenient districts by competent persons, the necessary funds to be raised from such districts by a very slight impost, not even exceeding one farthing on each ton of coal raised in it; and we believe that the cause of humanity, and the interests of the coal owners would be alike benefited by a well-considered legislative measure of this kind.

We have, &c., H. T. De La Beche,
Lyon Playfair.

Civ. Eng. & Arch. Jour.

New Preparation of Paper. *By* Professor Schoenbein.

Extract of a letter from M. Schoenbein to M. Dumas, dated 28th March, 1846.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The author has discovered a method by means of which the following properties may be given to the paper in common use:—

1. Prepared paper has much more tenacity and greater consistency than common paper.
2. When dipped into water, it does not lose its consistency, but is affected as parchment would be.
3. It receives, with equal facility, both writing and printing ink.
4. It does not require sizing to render it suitable either for writing or printing.

5. The injurious effects produced by the chloride of lime are avoided in prepared paper.

M. Schoenbein states that his process is simple, inexpensive, and easy of application, and that the new paper offers many advantages, particularly for bank-notes and for paper-hangings.

The vegetable fibre of this paper renders it possible to make of it a substance as transparent as glass, and impermeable to water. The author has made of it, bottles, balloons, &c., the sides of which may be made as thin as a plate of mica.

Another property of this paper is, that it developes a very energetic electric force. By placing some sheets on each other, and simply rubbing them once or twice with the hand, it becomes difficult to separate them. If this experiment is performed in the dark, a great number of distinct flashes may be perceived between the separated surfaces. The disk of the electrophorus, placed on a sheet that has been rubbed, produces sparks of some inches in length. A thin, and very dry, sheet of the paper, placed against the wall, will adhere strongly to it for several hours if the hand is passed only once over it. If the same sheet is passed between the thumb and fore-finger, in the dark, a luminous band will be visible. Hence, it is believed, that this prepared paper will answer to make powerful and cheap electrical machines.

Explosion from Fire Damp.

Dr. Miller, of H. M. St.-V. *Sidon*, dating from Greenhithe, Dec. 12, sent the following in a letter to the *Times*:—"Explosions from Fire-Damp, or carburetted hydrogen, on board of steam-ships being very rare, and the possibility of so serious an occurrence not generally known; I have to state that a violent explosion of this nature took place on board the *Sidon*, early this morning. The after-midship coal tank contained about sixty tons of coal, and the second engineer having removed the cover, he introduced a lamp into the tank, when the explosion immediately took place. The engineer had his face and hands severely burnt, and three other persons were injured, but not seriously." We believe the fire-damp was generated by the coal bunkers having been filled with water by order of Sir C. Napier, after the coals had been consumed, when the Sidon was towed down the river with the Lords of the Admiralty on board.

Nautical Mag.

INDEX.

List of American Patents, with Remarks, &c.

April, 1842.

26. Ploughs	George Watts	36
27. Cutting shoe soles	Elias T. Ingalls	37
28. Heating buildings	Reuben Mitchell	ib.
29. Growth of the hair	Vair Clirehugh	ib.
30. Tanning leather	Joseph Southwick	ib.
31. Sizing paper for cards, &c.	David H. Gilbert	38
32. Window shutters	Arthur L. Johnson	ib.
33. Cotton press	P. G. Gardiner	ib.
34. Stove for warming buildings	Salvin F. Kellogg	39
35. Ploughs	Thomas Wiard	ib.
36. Furnaces for manufacturing iron	C. E. Detmold, assig. W. Von Faber du Four	ib.
37. Churn	Lemuel Adams	40
38. Brick press	A. H. Fahnestock	ib.
39. Plotting surveys	Wm. S. Card	ib.
40. Fastening bedsteads	David Ball	180
41. Stop-cocks for water pipes, &c.	Jonathan Ridgway	181
42. Shoe for cure of hoof-bound horses	Daniel Homer	ib.
43. Padlocks	Wm. Ball	ib.
44. Setting logs in saw-mills	John Sheffield	182
45. Bedstead for invalids	William Woolley	ib.
46. Chimney caps	Stephen M. Allen	ib.
47. Cooking stoves	John Brereton	183
48. Hydro pneumatic lamp	Stephen S. Lee	ib.
49. Machine for tempering clay	R. Stillman & J. Taylor	ib.
50. Raising sunken vessels	Theodore R. Timby	ib.
51. Construction of umbrellas	Gilbert S. Ward	184
52. Power loom	J. Nield & C. Duxbury	ib.
53. Oiling cap spinners	Charles Danforth	ib.
54. Driving spindles of Danforth cap spinner	Do. Do.	ib.
55. Reaction water wheel,	L. W. & G. W. Blake	185
56. Waste gate of mills	E. Eastlack & J. A. Miller	ib.
57. Smut machine	James Durling	ib.
58. Punching metallic moulds of buttons	Alonzo C. Arnold	252
59. Upper stones of mills,	Joseph H. Burrows	ib.
60. Dressing stone	Theodore R. Timby	ib.
61. Coopers' tools	Samuel Widerman	253
62. Spring seat saddle	Foster D. Ward	ib.
63 Metal roofs	William Beach	ib.
64. Water in steam boilers, Height of	Charles Clinton	254
65. Cooking stove	Samuel B. Sexton	ib.
66. Spark arrester	A. Keagy & M. Shiner, Jr.	255
67. Liquor cocks	Charles A. Creasy	ib.
68. Measuring and cutting garments	Hiram Leger	ib.
69. Making sugar moulds	Antoine Carbonel	ib.
70. Bee hive	J. Milholland & B. Crane	256
71. Cork, or bottle stopper	Nathan D. Whitin	ib.
72. Percussion lock for cannon	E. Hidden & S. Sawyer	ib.
73. Piano fortes	C. Bossert & J. Schomacker	257
74. Stop-cocks	U. West & George Dobbs	ib.
75. Cut-off valves for steam engines	Horatio Allen	ib.
76 Propelling boats	Philip C. Traver	ib.
77. Reaction water wheels	Samuel B. Howd	258
78. Making candles	Ebenezer Marsh	ib.

December, 1845.

1. Water ram for raising water	Erastus W. Ellsworth	16
2. Pressing glass in moulds	Joseph Magoun	17
3. Portable cooking furnace	C. H. L. Webb	ib.
4. Cooking stoves	Samuel Pierce	ib.
5 Corn sheller	Thomas D. Burrall	18
6. Furnace for heating air	Ebenezer Barrows	ib.
7. Cotton gin	Theodore Ely	ib.
8. Furnace for heating apartments	Henry Katussowski & J. P. Wierzbicki	20
9. Combining canals and railroads	Samuel S. Walley	21

10.	Sails of vessels	James Maull	21
11.	Filter for inkstands	Walter Hunt	ib.
12.	Gates for fences	Andrew Hood	ib.
13.	Power loom	Robert P. Cunningham	22
14	Bathing apparatus	W. G. Young, assigned to A. H. Reiss	ib.
15.	Manufacture of sugar	Francis Duplessis	ib.
16.	Cooking ranges.	Wm. Beebe	23
17.	Water tables for doors	A. S. Pelton	ib.
18.	Restoring fullness of the cheeks	John Allen	24
19.	Manufacturing chewing tobacco	Henry Moore	ib.
20.	Attaching printing types to cylinder	Richard Hemming	ib.
21.	Fire engines	Ernest Marx	25
22.	Steam engine	John Ericsson	ib.
23.	Magnetic telegraph	Ezra Cornell	26
24.	Riveting sheet metal pipes	Jonathan Ball	ib.
25.	Cultivator	Allen Eldred	27
26.	Ivory comb plates	Calvin B. Rogers	ib.
27.	Iron truss for ships	John W. Wilson	ib.
28.	Double seaming tin-ware	Daniel Newton	ib.
29.	Beating and cleaning wire	John J. Howe	28
30.	Turning oar handles	Ezekiel Page	ib.
31.	Camphine lamps	James Maclean	ib.
32.	Cutting coats	Allen Ward	29
33.	Raising spring water	Benjamin S. Benton	ib.
34.	Bolting flour	Robert C. Mauck	30
35.	Cast iron railroad wheels	George W. Eddy	31
36.	Tubular steam boiler	James Montgomery	ib.
37.	Water wheel	John Mecay	ib.
38.	Composition cement for roofs	William Y. Singleton	32
39.	Grist mills	Josiah Platt	ib.
40.	Mill for grinding bark	Amos Lindsay	ib.
41.	Truss	Lorenzo D. Fleming	ib.
42.	Preserving potatoes	Charles S. Edwards	33
43.	Cooking stoves	Samuel Myres	ib.
44.	Reed musical instruments	Nathan B. Jewett	ib.
45.	Bee hive	James Robb	34
46.	Pulp strainer for paper makers	William Bishop	ib.
47.	Ascending inclined planes	Ezra Coleman	ib.
48.	Bee hive	Aaron Colton	ib.
49.	Refrigerator	Joseph T. Craddock	35
50.	Mounting booms of vessels	James Davis, Jr.	ib.
51.	Nails, pins, screws, blanks, rivets, &c.,	Samuel G Reynolds	ib.
52.	Applying medicated baths	Benjamin Sweet	36
	January, 1846.		
1.	Corn sheller	Elijah Converse	98
2.	Raising water from wells	Jehiel T. Farrand	ib.
3.	Stove for heating apartments	James Macgregor, Jr.	99
4.	Straw cutter	Joseph C. Rich	ib.
5.	Evaporating and concentrating fluids	J. J. Mapes & W. A. Cox	100
6.	Glazing cotton battings	Darius Goff	ib.
7.	Improvement in clocks	Thomas A. Davis	ib.
8.	Bee hive	Harvey W. Sabin	101
9.	India rubber boats or pontoons	Horace H. Day	ib.
10.	Preparing India rubber for grinding	J. W. Harmon	ib.
11.	Cooking stoves	Benjamin F. Dewolfe	102
12.	Improvements in bridges	Thomas Hassard	ib.
13.	Bedstead fastenings	Ebenezer Gassan	ib.
14.	Washing machines	Moses Chase	ib.
15.	Moulding vegetable substances	Charles Branwhite	103
16.	Making hat bodies	William Fosket	ib.
17.	Double seaming tin-ware	Joseph V. Hewes	ib.
18.	Oven cooking stoves	Lathrop S. Bacon	104
19.	Transparent covers for stoves	Henry C. Billings	ib.
20.	Cutting out ladies' dresses	Hiram Seger	ib.
21.	Washing machines	Charles King	105
22.	Coloring Daguerreotype plates	Frederick Langenheim	ib.
23.	Do. Do. Do.	I. B. Isenring, assigned to F. Langenheim	ib.
	February, 1846.		
1.	Straw cutter	Samuel G. Blackman	172
2.	Glazing cotton wadding	Jeremiah Essex	ib.
3.	Cooking stove	Joseph Lauback	173
4.	Horse power	I. J. Richardson	174
5.	Stove for heating	Charles W. Leet	ib.

6. Washing machine	J. H. Aldrich & O. C. Foote	174
7. Ovens of cooking stoves	George W. Eddy	175
8. Straw cutter	Joseph W. Webb	ib.
9. Weavers' temples	Arnold Palmer	176
10. Cooking stove	Samuel Graves	ib.
11. Safety cars for planes of railroads	John Tittle	ib.
12. Dressing mill stones	Elisha S. Snyder	177
13. Condensing and feeding apparatus for steam engines	Joseph P. Pierson, Jr.	ib.
14. Straw cutter	I. J. Richardson	ib.
15. Machine for sowing grain	W. J. Jones & H. C. Smith	ib.
16. Filter for water	William H. Jennison	178
17. Mortising machine	Benjamin H. Otis	ib.
18. Safety valve	John Shorb	179
19. Making candles	John Drummond	ib.
20. Cooking stove	Rensselaer D. Granger	ib.
21. Cutting and grinding fodder	J. Jessop, J. Wanbaugh, G. W. Ilgenfritz & J. C. Baker	ib.

March, 1846.

1. Chimney caps for ventilating	Moses Chase	234
2. Setting logs in saw mills	George Sweney	235
3. Cooking stove	R. D. Granger	ib.
4. Saw mills	R. S. Morrison & B. B. Cushing	236
5. Frictionless piston	David Hinman	ib.
6. Preventing hatches of vessels from leaking	Richard C. Holmes	ib.
7. Separating grain from the straw	Pliny Weller	237
8. Water filter	William H Jennison	ib.
9. Reaping grain	William F. Ketchum	238
10. Making soap	Dominique Frick	ib.
11. Mortise door latch	Rodolphus Kinsley	ib.
12. Door locks	John H. Davis	239
13. Manufacture of soap	J. K. Vaughan & E. H. Everman	240
14. Planting corn, &c.	James Putnam	ib.
15 Permutation lock	Francis B. Pye	ib.
16. Night or safety latch	Amos Call	241
17. Reaping, threshing, and cleaning grain	Jeremiah Darling	242
18. Pump for gauging the liquor	Daniel Hunsicker	ib.
19. Stop cocks for hydrants, &c.	F. H. Bartholomew	ib.
20. Blanks for wood screws	Solomon Merrick	243
21. Making white Rosin	Nicholas U. Chaffe	ib.
22. Separating grain from the straw	John Blue	ib.
23. Improvement in carriages	Starr Fairchild	244
24. Transporting, washing, &c. coal	John G. Brant	ib.
25. Dyeing furs	Denison Williams	ib.
26. Improvement in tea-kettles	Ezra Ripley	245
27. Centrifugal pump	William D. Andrews	ib.
28. Stop-cock or faucet	Thomas C. Clarke	246
29. Compound for cements	W. Yates & D. Dolan	ib.
30. Horse rake	Seneca Ladd	ib.
31. Horse rake	David Harkness	ib.
32. Finishing Daguerreotype miniatures	William A. Pratt	247
33. Fan blowers	Isaac P. Smith	ib.
34. Abdominal supporter	Edwin K Gale	ib.
35. Rotary centrifugal pump	Willis H. Johnson	248
36. Ventilating hat	Richard Halloran	ib.
37. Improvement in lamps	Samuel Rust	249
38. Do. trusses	J. Cooke & J. Strickler	ib.
39. Vegetable beer, or cream nectar	Simeon Whiton	ib.
40. Truss, or abdominal supporter	B. C. Everett, assignee of B. W. Stratton	250
41. Do. Do.	David B. W. Hard	ib.
42. Windows	James Ogden & D. R. Hart	ib.

Patents Re-issued.

1 Running gear of carriages	George Nichols	250
2. Driving shuttles in Power looms	Robert P. Cunningham	251
3. Making lead pipes	B. Jr., H. B. & G. N. Tatham, assignees of John & Charles Hanson	ib.

April, 1846.

1. Cutting screws on bedsteads	Hezekiah P. Nuckals	310
2. Gate for railroads	David Percival	ib.
3. Sulkey carriages	J. R. Remington	ib.
4. Filtering cock	Thomas F. Wenman	311
5. Constructing trunks	James Hobson	ib.
6. Purifying whale oil	Patrick Fitzsimmons	ib.

7. Filtering stop-cocks	Jonathan F. Ostrander	312
8. Propellers for steam vessels	Bennet Woodcroft	ib.
9. Printing presses	Alva B. Taylor	ib.
10. Self acting register for stoves	Washburn Race	313
11. Horse rake	Sorin M. Whitman	ib.
12. Rinsing cloth in calico printing	George J. Prentiss	314
13. Propellers for vessels	Daniel Deshon	ib.
14. Railroad wheels	Thomas Glasco	ib.
15. Moulding bricks	Joel L. Ransom	ib.
16. Churn	Charles King	315
17. Spring lancet	Jacob H. Gemrig	ib.
18. Brick press	Thomas Hartley	ib.
19. Combination lock	Joshua H. Butterworth	316
20. Magnetic telegraph	Samuel F. B. Morse	ib.
21. Lamps for light-houses	Charles Wheeler	ib.
22. Leather belts for machinery	William Kumbel	317
23. Planing and sawing lumber	Thomas J. Wells	ib.
24. Making bricks	Samuel Lowery	ib.
25. Straightening tobacco	George W. Macon	318
26. Cultivator	Nathan Ide	ib.
27. Corn sheller	Waldron Beach	ib.
28. Cutting and raking grain	Clinton Foster	319
29. Pocket-book and watch safe	Joseph Colton	ib.
30. Extension frame for bedsteads	C. S. Debou	ib.
31. Magnetic letter-printing telegraph	Royal E Morse	320
32. Plough	Samuel Witherow	ib.
33. Do.	Ruggles, Nourse & Mason, assignees of J. M. C. Armsley	321
34. Pumps	David G. Colburn	ib.
35. Manufacture of spoons	Joel Hall	ib.
36. Preparing flax and hemp	B. Langdon & A. Salisbury	322
37. Curry comb	William Wheeler	ib.
38. Water wheel	James Deniston	ib.
39. Manufacture of hat bodies	Henry A. Wells	323
40. Mills for grain, paint, &c.	William Broughton	324
41. Water wheels	Ralph Summers	ib.
42. Mail bags	Henry Johnson	325
43. Apparatus for printing calicoes	R. Ferguson & J. Clark	ib.
44. Measuring garments	Henry Donges	ib.
45. Improvement in mills	Jonathan F. Ostrander	326
46. Substitute for type metal	Josiah Warren	ib.
47. Drying sized paper	Joshua Norton, Jr.	328
48. Making bricks of dry clay	John Simpson	329
49. Ploughs	Harvey H. May	ib.
50. Making sand cores	H. Kellogg, assignee of J. Kellogg	ib.
51. Hay press	Daniel R. Allen	330
52. Rolling tobacco	William P. Marston	ib.
53. Making hommony	William Y. Singleton	ib.
54. Ventilator for chimney tops	Michael Collins	ib.

Additional Improvements.

1. Furnace for burning bricks	Joel W. Andrews	331

May, 1846.

1. Plough	John M. May	374
2. Lamp for burning lard and oil	John Street	ib.
3. Bolting flour	Elisha S. Snyder	375
4. Wind mill	Allen Judd	ib.
5. Preventing passage of air and water under doors	Luther Gifford	ib.
6. Plough	John M. May	376
7. Cutting shell, or horn	Joel R. Morse	ib.
8. Sash fasteners	William S. McLean	377
9. Washing and amalgamating gold and silver	Daniel Asbury	ib.
10. Overshoes	Andrew Vetter	378
11. Composition for blacking	Joseph Hayward	ib.
12. Tuning metallic reeds of seraphinas, &c.	J. Shaler Ives	ib.
13. Shovel plough	Moses D. Wells	379
14. Bee hives	William R. Kelsay	ib.
15. Protecting bees from the moth	Daniel Arndt	ib.
16. Propelling boats, railroad cars, &c.	Josephus Echols	380
17. Preserving corpses	R. Frederick & G. A. Trump	ib.
18. Mode of making spoons, ladles, &c,	Walter W. Hart	381
19. Turn key for drawing teeth	Hiram Todd	ib.
20. Machine for cutting meat	Abisha Clark	ib.

21 Fastenings for bedsteads	J. Haslet & C. Devitt	382
22. Machine for making harness	Samuel Wilson	ib.
23. Shaving and jointing staves for barrels, &c.	John H. Lester	383
24 Railroad switches	Philos B. Tyler	384
25. Cleaning wheat, &c.	J. W. Howlet & F. M. Walker	ib.
26. Applying water to water wheels	J. K. Millard	ib.
27. Pickers for looms	Benjamin A. Holbrook	385
28. Furnace for smelting iron	A. Ellicott & A. McCrove	ib.
29. Hot-air back for cooking ranges	H. H. Stimpson	386
30. Water wheels	Christopher Hand	ib.
31. Cure of spinal diseases	John L. Sullivan	ib.
32. Sugar pans for evaporating	Alfred Stillman	387
33. Cooking stoves	John Lee	ib.
34. Moulding and pressing bricks	Thomas Culbertson	ib.
35. Improvement in stoves	L Morse & W. J. Lewis	389
36. Andirons for fireplaces.	John R. Remington	ib.
37. Smut machine	Henry Staub	ib.
38. Making wrought nails	Albert W. Gray	390
39. Do. iron directly from the ore	J. F. Winslow	ib.
40. Feeding furnaces for smelting	Squire M. Fales	391
41. Improvement in stoves	James Wilson	392
42. Propelling boats	William P. McConnell	ib.
43. Improvements in locomotive engines	Matthias W. Baldwin	ib
44. Auger for boring the earth	Jonathan Hobart	393
45. Hot-air furnaces	William G. Wing	ib.
46. Forge bellows	Jeremiah Darling	ib.
47. Reaming the bands of brass faucets	William Read	ib.
48. Excavating ditches	William Y. Singleton	394
49. Water wheel	F. P. Haviland & E. Tuttle	ib.
50. Improvement in the Jacquard frame	John Perrins	ib.
51 Registers for hot-air furnaces	Ebenezer Barrows	395
52. Ditching machine	J. R. Remington	396
53. Manufacture of iron and steel	Charles Low	ib.
54 Steam whistle for locomotives	Matthias W. Baldwin	398
55. Balance valves of steam engines	W. H Baker & H. R. Worthington	ib.
56. Improvement in stoves	John B. Clute	ib.
57. Do. the plough clevis	Charles L. Meech	399
58. Rotary steam engines	Richard Field Stevens	ib.
59. Furnace for steam boilers	Henry F. Baker	ib.
60. Excavating and removing earth	D. Carmichael & J. C. Osgood	400
61. Cutting threads of screws	Thomas W. Harvey	ib.
62. Improvement in the plough	David Anthony, Sr.	403
63. Cooking range	Julius Fink	ib.
64. Cutting corn and brush	Edwin Owens	ib.
65. Improvements in the plough	James Johnson	ib.
66 Cultivator for cotton	John Merrill Cullen	404
67. Steam boilers	Elkanah Ingalls	ib.
68. Rotary steam engine	James Black	ib.

Acid, Concentration of sulphuric 144
Accidents on railways in Europe, ... 370
Analysis, Notice of a gas furnace for organic 140
Architect. By W. H. Ranlett. Notice of the . . : 72
Architecture, Notice of publications on Gothic . . . 346
Armament for war steamers, ... 423
Art-Union Monthly Journal of the Fine Arts, Notice of the . . 422
Artists, Experiments on tanned canvas for the use of . . 144
Assaying crystallized sugar, as well as sirups, by means of lime, Process of . 50
Axles, Vibrating box for locomotive,—*patent* . . . 408

Baltimore and Ohio Railroad Company, Annual report of the . . 173

Bibliographical Notices.
  Art-Union Monthly Journal of the Fine Arts, . . 422
  Dr. Gardiner, on the chemical principles of the rotation of crops, . 106
  Gothic architecture, ... 346
  The Architect By W. H. Ranlett 72
  The Literary World, a Gazette for Authors, &c., . . . 272
  Urling's translation of the law of patents in foreign countries . . 421

Black band ironstone, Account of Muschet's 71
Blast pipe, Explosion of a 208
Blasting under water with gunpowder, ... 353
Blowpipe, Dr. Hare's improvement in the hydro-oxygen . . 1[illegible]6
Boilers, &c., Apparatus for riveting plates for—*patent* . . . 44
Box for locomotive axles, Vibrating—*patent* 408
Bridge, Experiments at Blackwall on the Menai tubular . . 303
——— rails, Iron 374

Canal, Account of the Helder or Great North Holland . . . 371
—— across the isthmus of Panama, . . . 304 361
—— commissioners of Pennsylvania for 1846, Report of the . . 145
—— locks, Report on Lawthorp's wicket gate for . . . 269
Cannon balls on iron steamers, Effect of 71
Canvas for the use of artists, Experiments on tanned . . 144
Cast iron, Mode of skimming ladles for pouring . . . 274
—— and steel, Action of air and water on wrought and . . 124 187
Cement, Notice of a metallic 286
Centre punch, Description of a 274
Chemical principles of the rotation of crops, Dr. Gardiner on the . . 106
Chemitype printing, Description of 142
Clock at the university of Paria, Magnetical 287
Coal of Silesia, Remarks on the origin of the . . . 215
Coast of the United States, Notice of the report on the survey of the . . 186
Cocks, Improvements in Sluice—*patent* . . . 45
Cohesive force of water, On the 69
Collieries, and the means of prevention, Gases and explosions in . 347 427
Convention of inventors held in Philadelphia, October, 1846, Proceedings of the . 41
Copper district of Lake Superior, Remarks, by Dr. Pettit, on the . 338
—— without cyanuret of potassium, Process of coating iron and zinc with . 216
—— wire rope for lightning conductors, . . . 426
Cornish engines, Account of the 16
Corrosion of iron rails in and out of use, ... 139
—— metals, Experiments on the 274
Cotton, On the preparation, properties, and practical uses of Schoenbein's gun 282
—— to mining purposes, Applicability of gun . . . 70

Damp, Explosion from fire 434
Dock-gates at Sevastopol on the Black Sea, Description of the iron . . 278
Double seaming tin-ware, Report on apparatus for . . . 266
Driers for finishing paper, Legal decision on Knight's patent for . . 408

Electrical machine, Account of a powerful 287
Enameling the surface of cast-iron,—*patent* 265
Engineers in France, Number of government 15
Engine, Vibrating marine 71
Engines, Account of the Cornish 16
Explosion of a blast pipe, ... 208
—— the locomotive "Neversink," upon the Reading railroad, Report on the 331
—— in collieries, and the means of prevention, Gases and . . 347 427
—— from fire damp, ... 434

Fire damp, Explosion from . . . . . ib.
Force of water, On the cohesive 69
France, Number of government engineers in 15
French railway regulations 301
Furnace for organic analysis, Notice of gas 140
FRANKLIN INSTITUTE.
  Committee on Science and the Arts.
    Report on Moore's apparatus for double seaming tin-ware, . . 266
    —— Lowthorp's wicket gate for canal locks . . . 269
    —— explosion of the locomotive "Neversink," upon the Reading railroad, 331

Galvanic magnets, Apparatus for measuring the force of . . 286
Gardiner, Dr., on the chemical principles of the rotation of crops . 106
Gas for illumination, Making retorts for generating—*patent* . . 46
—— from water, Manufacture of 52
—— furnace for organic analyses 140
—— lighting, Dr. Hare on hydrogen for . . . 144
Gases and explosions in collieries, and means of prevention, . . 347 427
Gates at Sevastopol on the Black Sea, Description of the iron dock . 278
Gauge for railways, Reasons for the adoption of the usual . . 15
Gauges, Analysis of the evidence on the diversity of railway . . 9 85 157
Glass, Notice of Schonbein's malleable 285
—— On the manufacture of ruby 359
Glazing and enameling the surfaces of cast iron,—*patent* . . . 265
Gothic architecture, Notice of publications on . . . 346
Grape sugar, Notice of 286
Great Britain, Cost of railways in 15
—— On the iron manufactures of 210
Gun cotton to mining purposes, Applicability of 70
——, On the preparation, properties, and practical uses of . . 282
—— powder as an instrument for blasting, Application of . . 353
——, Faraday on the manner of the action, &c. of . . 284

Hemp, linen, timber, &c., Burnet's method of preserving 67
Holland canal, Account of the Helder or Great North 371
Hudson river railroad, Western trade in reference to the proposed 166
Hydraulic ram, Improvement in the—*patent* 404
———— Notes on the 133
Hydrogen for gas lighting, Dr. Hare's note on 144
Hydro-oxygen blowpipe, Dr. Hare's improvement in the 196

Illumination and ignition, Improved means of—*patent* 263
———— from water, Manufacture of gas for 52
————, Retorts for generating gas for—*patent* 46
Inventors, held in Philadelphia, October, 1846, Proceedings of the Convention of 41
Iron and zinc with copper, Process of coating 216
—— bridge rails, 374
—— dock-gates at Sevastopol on the Black Sea, Description of the 278
——, Glazing and enameling the surfaces of cast 265
——, Improvement in the manufacture of—*patent* 48
—— manufacture of Great Britain, On the 210
——, Mode of skimming ladles for pouring cast 274
—— rails in and out of use, Corrosion of 139
—— ships, On the action of air and water on 124 187
—— steamers, Effect of cannon balls on 71
—— war steamers of Great Britain, 70
Ironstone, Muschet's black band 71
Isthmus of Panama, Canal across the 304 361

Knight's patent driers for finishing paper, Legal decision on 408

Lake Superior, Dr. Pettit's remarks on the copper district of 338
Legal decision on Knight's patent driers for finishing paper, 408
Lightning conductors, Copper wire rope for 426
Lime, Process for assaying crystallized sugar, &c. by means of 50
Linen, hemp, timber, &c., Burnett's method of preserving 67
Literary World, a Gazette for Authors, &c., Notice of the 272
Locomotive "Neversink," upon the Reading railroad, Report on the explosion of the 331
———— axles, Vibrating box for—*patent* 408

Magnets, Apparatus for measuring the force of galvanic 286
Magnetic investigation, Results of an extensive series of 65
Magnetical clock at the university of Paria, 287
Malleable glass, Notice of 286
Marine engine, Vibrating 71
Mining purposes, Applicability of gun cotton to 70
Morin's notes on measurement of water delivered through wide orifices, 93
Muschet's black band ironstone, 71
Menai tubular bridge, Experiments at Blackwall on the 303
Metallic cement, Notice of a 286
———— pens, On the manufacture of 114
Metals, Experiments on the corrosion of 274

New York and Erie railroad, Report of Commissioners to locate the 217 289
Nicaragua route for a canal across the isthmus of Panama, 304 361
North Holland canal, Account of the Helder or Great 371

Organic analyses, Notice of a furnace for 140

Panama, Extracts from an examination of the isthmus of 304 361
Paper, Legal decision on Knight's driers for finishing 408
——— by Prof. Schoenbein, New preparation of 433
Patents in foreign countries, Notice of Urling's translation of the law of 421
Pennsylvania, for 1846, Report of the canal commissioners of 145
Pens, On the manufacture of metallic 114
Pins, Improvements in the manufacture of 206
Plates for boilers, &c., Apparatus for riveting—*patent* 44
Potassium, Process of coating iron and zinc with copper without cyanuret of 216
———— and sodium, Making the cyanides and ferrocyanides of—*patent* 258
Potteries and history of the art, Account of the Staffordshire 56 116
Printing, Description of chemitype 142
Prussian patent laws, Operation of the 287
Punch, Description of a centre 274

Rails, Iron bridge 374
——— in and out of use, Corrosion of iron 139
Railroad, Report of commissioners to locate the New York and Erie 217 289
———— on the explosion of the locomotive "Neversink" on the Reading 331
———— Company, Annual report of the Baltimore and Ohio 73
———— Corporation, Annual report of the Western 367

Railroad, Western trade in reference to the proposed Hudson river 166
Railway bills reported to the House of Commons, Account of the 16
——— gauges, Analysis of the evidence on the diversity of 9 85 157
———, Notice of stone 287
——— regulations in France, 301
——— statistics of accidents in Europe 370
——— system, Protracted progress of the 373
——— trains at high velocities, Law which governs the resistance to the motion of 231
Railways in Great Britain, Cost of 15
———, Reason for the original adoption of the usual gauges for 15
Ram, Improvement in the hydraulic—*patent* 404
—— Notes on the hydraulic 133
Refraction, Observations on the phenomena of terrestrial 279
Retorts for generating gas for illumination,—*patent* 46
Riveting plates for boilers, &c., Apparatus for—*patent* 44

Saccharimetric process, 50
Sailing power of yachts built on the wave principle, 140
Schoenbein, New preparation of paper by Prof. 433
Self-registering instruments, 136
Silesia, Remarks on the origin of the coal of 215
Sluice-cocks, Improvements in—*patent* 45
Sodium and potassium, Making the cyanides and ferrocyanides of—*patent* 258
Staffordshire potteries, and history of the art, Account of the 56 116
Statistics of accidents on railways in Europe, 370
Steamers, Armament for war 423
——— Effect of cannon balls on iron 71
——— of Great Britain, Iron war 70
Steel, Action of air and water on wrought iron, cast iron and 124 187
——— Magnetic investigation, including most of the known varieties of 65
Stone railways, Notice of 287
Sugar, as well as sirups, Process of assaying crystalized 50
——— Notice of grape 286
Sulphuric acid, Concentration of 144

Specifications of Patents.
  Hydraulic ram, Improvement in the—*Strodes'* 404
  Ignition and illumination, Improved means of—*Greener & Staites'* 263
  Iron, Glazing and enameling of cast—*Kenrick's* 265
  —— Manufacture of—*Rushton's* 48
  Potassium and sodium, Making cyanides and ferrocyanides of—*Laming's* 258
  Retorts for generating gas for illumination—*Cowen's* 46
  Riveting plates for boilers, &c., Apparatus for—*Garforth's* 44
  Sluice-cocks, Improvements in—*Waller's* 45
  Vibrating box for locomotive axles,—*Norris & Tull's* 408

Tanned canvas for the use of artists, Experiments on 144
Terrestrial refraction, Observations on the phenomena of 279
Tidal observations made in Plymouth dock-yard, 1831 to 1833, 213
Timber, hemp, linen, &c., Burnett's method of preserving 67
Tin-ware, Report on apparatus for double seaming, 266
Tubular bridge, Experiments on the Menai 303
Tyler, P. B. Esq., Extract of a letter from 273

Velocities, Law which governs the resistance to the motion of railway trains at high 231
Vibrating box for locomotive axles—*patent* 408
——— marine engine, 71

War steamers of Great Britain, Iron 70
Water delivered through large orifices, Measurement of 93
———, Manufacture of gas for illumination from 52
———, On the cohesive force of 69
Wave principle, Sailing power of yachts built on the 140
Western Railroad Corporation, Annual report of the 367
——— trade, Observations on the 166
Wicket gates for canal locks, Report on Lowthorp's 269
Wire rope for lightning conductors, Copper 426

Yachts built on the wave principle, Sailing power of 140

Zinc and iron with copper, Process of coating 216

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